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Main introduction

The main research question deals with the real use of objects addressing diverse human factors (and actors) following theoretical and practice-led lines of inquiry, enabling the author to answer his open questions about the real use (and usability) and a definition of perceived affordances of objects. The author´s contribution to the discipline can be summarised as a major step towards gaining an (informed) understanding about affordances of objects supported by tactile data. The concept is important because the data gathered provides evidence and builds up the confidence of designers during decision-making processes and in argumentative negotiations with scientists, theorists and practitioners. The practice-led result, the tool-kit to collect (precise) tactile data applicable to a number of mass products, provides both the design community and non-design experts, such as social scientists, with a reliable method to record and decode human touch on complex three-dimensional basic commodities and everyday objects.

The notion of materiality is almost not recognised - at least from the author´s experience - in the design and production of mass-ware, universal products or objects in public. A more philosophical, psychological and cognitive focus is necessary in the process of designing objects. The sense of touch in particular is an almost ignored area in design practice, with regard to making decisions, setting priorities and evaluating and configuring the demands of a physical product. It is recognised here that materiality cannot be detached from objects. Further the perception of object materiality is affected by the object´s authority, by cultural traditions and contemporary societal and political values?

The author´s motivation, underlying this current research project, lays in and is driven by conducting of experiments with objects, surfaces and the meaning of (human) touch, and beyond that aims at the development and realisation, to institute a true, scientific method to interpret behaviour, and behaviour patterns, in the context of human interaction with an everyday objects. The author´s goal is to present a reliable tool enabling non-experts and experts to recognise, capture, measure and interpret human touch on objects in order to design objects which suit people´s real, diverse and true needs, demands and requirements.

Due to the complexity of domains and different knowledge streams, the cross-disciplinary proposal of the research project and lack of transparency by the network of subjects, it was significant and essential for the success of the research practice to explore and expand the discourse from the relatively narrow topic of user-centredness to a much wider subject and the broader question of who a user seems to be, what an object seems to be and what a surface seems to be. The author has previously discussed precedent human-centred design methods with reference to popular scholars such as Potter (1980), Jones (1992), Goel (1995), Clarkson (2003, 2008), Krippendorff (2005), Merriam (2009) and Kluever (2011) but mainly isolated from other disciplines without allowing scholars from other fields such as cultural studies (Miller, 1998, 2010; Dant, 1999, 2005; Ingold, 2007-10), philosophy (Latour 1992, 1996, 1999; Gibson 1986) and anthropology (Gosden 2005; Gell, 1998; Knappett 2005, 2008; Malafouris 2010) and social technology (Winner 1980, 1986; Plant, 2008; Featherstone, 1999; Cooper, 2003) to get a chance to speak.

The author is interested in the question to reveal if the notion of human touch, tactility in the context of embodiment and the concept of „decoding latent human traces on man-made objects“ in the research practice can become a valuable method to understand human behaviour. And furthermore, if the data - and the process of collection, interpretation, analysis and visualisation - can become a design research tool which is repeatable and generally applicable to the process of design. The tool-kit should be deployed to search for clues in iterative design processes through the use of hardware and software by digitised data processing. In order to address and deal with the research question above holistically, it is essential to integrate and embed the knowledge from former unknown scholars in the theoretical analysis. Re-developing the theoretical part of the dissertation was critical for the author´s understanding of the general topic and explicitly discussing

his research questions and has further created a distance to the specific discipline of design by widening the field and lines of enquiry to the subject chosen. To explain in further detail, the author has run different knowledge streams, i.e., behavioral science, psychology, cognitive science, social cognition, social psychology, ethnography, semantic networks to understand the apparent interrelationship between the human condition and man-made objects in depth, sometimes in parallel and sometimes cross-linked in order to present a foundation for the development and implementation of the touch-sensitive prototypes and object skins.

Some knowledge streams have been stopped at some point in the discussion, i.e. ethology, archaeology, art history, literary studies, cultural heritage, consumer behaviour, media psychology and material science due to the fact that the input became too detailed, specific or irrelevant to the main subject. Some knowledge streams, such as social science, cognition and psychology have been discontinued, some seem disconnected and ill-placed, but have been reactivated and reanimated later in the discourse. The domain of anthropology and social and political relationship, not only between objects and users, but between objects and objects as networks in communication, correspondence and interaction as agents for actors. Further the Thing Theory (Heidegger 1971, Brown 2001) distributes key findings with regard to the distinction between things, objects and subjects, gifts and ownership. The concept and act of naming or labelling things emerged to be highly relevant for the research practice due to the fact that the series of touch-sensitive prototypes can act to release and „freed“ from purpose, category and meaning. It was sufficiently important for the development of the research project to `zoom-out´, open the field of discussion about, for example, users in general and non-human animals (Uexküll 1957, 1982, 1992) and non-human agency (Latour 1987, 1992, 1999), to then be able to narrow down and focus the discourse on the specific area of enquiry in order to redirect the research focus.

Surface touch, the meaning of objects, uses and users are important variables to discuss and define design parameters and the object-user or user-object relationship, both prior to and during the development of the touch-sensitive prototypes and probes. Thus it became, for instance, evident through the theoretical discourse that materiality has a relevant psychological impact on the actor´s behavior (and relationship to the object or thing) which remains inseparable from the object´s meaning (attached and) defined by each actor differently. Thus the author gave up any specific naming, established purpose or meaning from/of the touch-sensitive prototype (during test and trial) aiming for the proband to act with as minimal bias and presuppositions as possible. This technique has allowed the author to collect a wide range of different behavioural patterns enabling the researcher to generate a number of different categories of use. The specific knowledge gained at this stage is derived from different streams of knowledge from core fields such as cultural studies and psychology, and in particular cognitive science, material culture, phenomenology, philosophy, computer science and more.

The theoretical input has described the notion and provided significant insights about the concept that computer work has fostered undeniably the alienation of labour or physical work towards the nature of the body. The human disembodiment has forced to simulate the physical world and haptic experiences via photo-realistic virtual worlds in real time and in the art of of novel input devices as the extension of the human body. One of the major contextual implication (and importance) of including philosophy (Latour 1992, 1996, 1999) and material culture (Dant 2005, Miller 2010, Ingold 2010, Fowler 2010, Brown 2005; Holbraad, Henare, Amiria 2007) into the current research project derives from the fact that those disciplines put the relationship between human animals and objects or things in a different, often non-consumer and far from any question about profitability, perspective which relates to the act of designing objects differently. Those views towards the meaning of objects tend to be ignored by professional designers. Although social science plays a key role by gaining an in-depth understanding about the human behaviour and the social dynamics, but the significant difference lies in the fact that social scientists reject to create and deliver appropriate design solutions (for the problem discovered) which is certainly

the core expertise of industrial designers. Initially, it might be not possible for the reader to understand why the author begins and follows the approach of discussing the behaviour of non-human animals and, for example, their perceptual cues (Uexküll 1982, 1992), their image-schema (Johnson 1987; Lakoff 1980, 1987), and their responses to physical stimuli. But the reasons for doing this will be explained in the conclusions of each chapter of this paper, discussing parallel approaches from intuition to childlike behaviour with the environment, outdoors and indoors, and objects. Substantial parameters such as size, viewing angles, and relation to human body size are discussed in specific paragraphs of chapter 2.

In the first chapter is mainly concerned with the definition of what comes first, the driving force of interactive encounter, the user´s intention, demand, duty and enquiry, or the object´s demand, responsibility, or intention, if this might exist in the object world or object network. This debate leads to the argument of the research practice to measure, and simultaneously observe, human behaviour via a probe simulating an everyday human task (Gibson 1979). The second chapter provides the reader (and the author) with significant conclusions about the key question of what an object is, and discusses different schools and scholars addressing the term of thingness and the relationship between objects, things and names. In the first chapter the initial point of the discussion is viewed through the perspective of the user directed to the object world. Chapter 2 deals with the intention and thoughts derived from objects, ignoring the demands from actors summarised in chapter 1 including Brown´s position of a thing remains un-nameable (2003), Schwenger´s statement that thingness of a thing is untouchable (2001) and Gosden´s call that things are defined by appearance, location and setting (2004) rather than words. Gell (in Gosden 2005) also suggests the idea to discuss the impact of the material world on to how it affects human relations. The third chapter mainly discusses the meaning of physical and spatial surfaces in both the man-made and the natural world. Most interestingly, most scholars (Miller 1998, 2010; Dant 1999, 2005; Ingold 2007, 2010) refuse to consider the notion of material sampling as a form of documenting and interpreting the bodily engagement with the world. Herewith not only the image derived from the carving is a manifestation of human occupation, but also the material, the sample, removed from the surface most of the time left unappreciated on the floor or remain in the carving tool. From a trace analyst´s perspective the material sample, removed from a wall or floor of a (crime) scene is the most important evidence to reconstruct a past scenario.

Chapter 1

Human and non-human user-related use and object-related use

Introduction

This chapter is about user and user interaction. It discusses the usage, operation and handling of objects focussing on the actor in the world of objects and materiality (Miller 2010, Dant 2005, Ingold 2009). It deals with the usage of objects perceived by humans through surface touch and in contrasting juxtaposition with non-human animals (Latour 1987, Uexküll 1992). Human animals are driven by intuition, by childlike curiosity, by necessity, by authority or by the impulse or desire to make, alter, improvise or misuse material objects (to support mind, body, individual jobs and task, and quality of living). Non-human animals are driven by their natural instinct, by their innateness to act and react to perceived images and patterns, and react to public domain stimuli such as visuals or smell. This chapter relates to a variety of different subjects, themes and arguments. Some of these are closely, directly, and in places loosely related to the correlation between the actor and the counterpart, i.e. object and others deal with the object and its attached meaning in the physical world.

The relationships between object and user, or user and object - the established path of interaction, action and reaction - is reconsidered here, discussing also the shift from usefulness to a status of uselessness (Brandes 2009, Fulton Suri, Wentworth 2005). According to Norman (1999, 1988) and his definition of affordances, later revised to perceived affordances, the chair, as an established object since childhood memories, suggests or offers to sit down. The author explains impulse-giving of our cognitive system (Malafouris 2004), multiple use of objects (Gibson 1977) and body-motoric actions derived from the object´s world (Gell 1998). The chapter also provides brief insights into the *`designerly´* approach to problem solving (Schön 1983, Lawson 1980, Cross 1982) juxtaposing designers' approach to problem solving with that of scientists?

1.1 Affordance theory, lobbyist and a jumping dog, a blind man´s world, free will vs inner voice

This paragraph discusses popular scholars on the theory of affordances. It defines the actor´s role in the *Umwelt* and in relation to objects, describing exemplar from the non-human animals´ world. A commonality has been recognised (in the literature) of Latour´s concept of the *`hole-wall dilemma´* with the mastery of an automatic door and Uexküll´s concept of a non-human animal´s instinct-disabled attitude to serve a superior human animal and to enter the blind man´s world.

Referring to Gibson´s theory of affordances (1979), a chair, or any horizontally-aligned surface with the same coordinates, size, dimension and scale offers or commands or educates actors to sit down. It can´t be questioned that the use of a chair is a clear, well-defined receptor-image relationship to most people, in the Western world however, related to the form, outline and semantic image which is well-established since childhood. A human being, referring to Gibson, acts in a same way and applies a similar set of action like a sea urchin does in different situation, who is *`an animal that operates on a purely reflex plan´* (Uexküll 1992: 359). To draw upon a less far distant exemplar let us refer to a dog´s behaviour pattern for a moment. A dog can be trained to do certain performances, tricks, attitudes and operative sets of action and to act upon certain stimuli. A well-trained and semi-skilled dog listens to the voice and sound of its owners (*Herrchen* or *Frauchen*), or any other superior human or non-human animal, responds and follows to their recallable actions. Although it might appear and sound unnatural for a dog or any other animal to jump on a chair, but the dog will do the set of actions repeatedly if *Herrchen*

or *Frauchen* tells him or her to do so. The idea or theory of (re-)adjusting the obedience, instruction and control provided through the exemplar of non-humans, is likewise an approach to be found in humans. Often actors listen to their inner voice in order to react to object-stimuli and adjust behavior accordingly. The inner voice, giving them orders, can be formulated and postulated by past experience, by convenience, (bad) habit or daily routine, by social context and interaction in a group, and so on. All those presuppositions, those implicit assumptions, control the way actors negotiate with, balance and judge the subjectivity within the perceived affordance. Closing the argument here, it might be the case that occasionally human actors, as well as non-human animals, do obey someone, an intrinsic-conscious superior, an inner voice from a superior such as a *Herrchen* or *Frauchen*, with regard to judging specific behaviour to an object. (Who or what sense calls an object useless and meaningless or useful and meaningful?) A dog is prepared and bodily capable, based on its anatomy and physically dynamic form, to run, jump and play as those motions lay in his or her instinct to hunt, eat and flee. The attiude of jumping on a chair does seem to be alien for the species, considering the height, form, appearance, colour, materials and odour of a man-made object. Recalling this specfic set of motion solely on the command from a superior figure seem to be an unexpected behaviour pattern. But more surprisingly might be the phenomena how guide dogs, psychological attached to its *Herrchen* or *Frauchen* authority, both mutually depending on eachother, cope with everday life. Uexküll refers to the relationship as follows:

The difficulty of training the dog lies in introducing into the dog´s *Umwelt* specific perceptual cues which serve the blind man´s interests, not the dog´s.

> […] The edge of a curb, over which the blind man might stumble, is equally hard to introduce into the dog´s world, since under ordinary circumstances a freely running dog scarely notices it. (Uexküll 1992: 363)

In conclusion the *Freigeist* (free spirit, individualist) in a dog´s repertoire of mind and conscioness remains isolated, kept locked away, kept disabled, maybe has been erased to serve a superior animal. The explorative nature applied by children playing, running, jumping, turning, twisting, bending and exploring versatile multi-layered postures on, around and with a chair occurs to be an attitude of exactly the free spirit, you will find in wild animals, followed by human instinct to engage with matter and substance. It must be explained that a human perceptor system and cognitive network are far more complex, in juxtaposition to a dog´s ones, to apply diverse coping strategies in order to pursue, process and conquer inherent perceptual cues. Referring to Gosden´s (2005) conclusion that our senses are structured and educated by the objects that surround us since childhood, the allowance to use an object without presuppositions seems to be limited, restricted and primarily needs to be authorised by the user´s own, and in most cases interlinked with its social, political and societal power system of norms and values. Uexküll concludes that our acts are presupposed, however Norman´s view could be described as a biased act of intrinsic-control rather than extrinsic-controlled perception enabling the actor-object encounter to be predicated on a wider scope, with a liberal and tolerant view. The question to be asked is: who has isolated, erased and killed the *Freigeist* to stop adults from interacting, using and corresponding to everyday objects intuitively, detached from presupposition, constraint and rules? Maybe that is the reason why people in a certain age are prone to fitness, extreme activities and life-threatening sport involvement in their spare time to cope with the inherent necessity to exercise, explore and renegotiate vital matters.

1.2 Actors, young and old, in the process of unlearning the touch of exterior skin

As discussed above one of the implications of Gibson´s theory of affordances is the application of object agency and the education of the actor. Turning now to this issue with the argument that the relationship between actor and object is a process of adjustment, as some scholars might say, it remains a constant (re-)balancing act. This section entitles users, or actors, to act differently following their preconception, *Umwelt* (Uexküll 1957)

and past experience. The argumentation is built on frequently-used studies but expands the topic in detail with further exemplars. It underlines the concept that children do inherit an amateurish take on objects, albeit adults seem to have unlearned (or are denying) to impinge with the skin of the exterior.

The interrelated relationships of users and physical objects are influenced and controlled by a number of spatial and dimensional parameters such as size, form, shape, proportion, alignment, and coordinates in space, and their perceived relationship to the human scale. For instance, comparing the way that a child engages and interacts with a chair in a different way to an adult. Ignoring the fact that both actors occupy different levels of intellect, but, referring to the apparent divergence of physical, body size-related capability, and addressing human requirements, needs and demands. An adult might see, perceive and interpret a chair for comfort, a child for something quite the opposite, for shelter or to rise above things. The interaction or the use of an object described by the author (and other scholars) above, differs from how Gibson (1977) defines the operational use of an object. The affordance of the chair, for example, juxtaposed with Gibson´s theory which, in general, disallows multiple use of on object. The author argues that the relationship between an object and the user works independently and cannot be measured nor the user's actions predicted. Gibson´s affordance theory defines the effect from a visual image towards its receptors in just a single direction. A chair is meant to support sitting, a bottle is designed to contain and conserve fluid over time, a gun is a device to defend aggression and conquer a combatant. Gibson´s concept is ill-conceived as it disallows any forms of individual interpretation of the character and actor, applied to the user‘s own inherent intentions with the object(s). The relationship between actor and object is a constant process of adjustment and readjustment, negotiation and renegotiation, as each element, party and body involved advocates personal stakes, goals and interests. The object is linked to a lobbyist, as is the actor. It is a multi-directional, interactive stream. Considering the localisation of objects, and along comes the specification of context, a further level of negotiating and renegotiating boundaries is required to describe the relationship between objects and characters. The change of territory brings a contextual shift to the receptor´s familiarity to the established path with the visual, situation or event, a familiar path referring to Uexküll (1957, 1982), and demands reevaluation and reapproval of the relationship between parties involved. Gibson´s concept objects to the concept of reciprocal negotiation between humans and non-human agencies. Even if actors are colonise in the same *Umwelt*, they can have different perceptual paths. The relationships between object and user, or user and object - the established path of interaction, action and reaction - are exposed to constant change. The author considers an object to act, in addition to the user or actor, capable of both roles: passively and actively involved in defining both the meaning of the object and the user's interactions with the object.

The change of a perceived image, the change of colour caused by sunlight, the change of perception of shape due to the user´s mobile motion and the resulting change in perspective, and so on, can all result in the object defining user perception and action and occasionally can force users to renegotiate their behaviour. Due to its complex form and reflective surface texture, the perception of a car´s silhouette is prone to change with changing intake and angle of light. A melting candle changes its shape over time mediating different actions. The change of form derived from the change of surface materiality appearance radically influences the way users perceive an object because the change needs not only further information processing but also constant renegotiating and deliberating of past experiences, values and meanings. According to Norman (1999, 1988) and his definition of affordances, later revised to perceived affordances, the chair, as an established object since childhood memories, suggests or offers to sit down. This set of actions is recalled universally, despite the fact that the user might bring personal intentions to the specific context, onto the plot or setting which the object is placed, materialised and embodied in. The individual‘s past experiences might differ from the authority of approaching, interacting with and using a chair-like object. It must be argued that depending on previous felt experiences the user acts prejudiced, biased towards the immediate encounter with the object. Even the perception of cues might be out of

question in order to choose favorite means of embodied contact: hand touch, body touch, subtle body touch, body hair touch? Although in The Descent of Man, Charles Darwin (1871) identified useless body parts, among others wisdom teeth and body hair was described as nearly useless, and subsequently no longer subject to natural selection of mankind. Considering the prevalence of a person´s inherent own preference of forms of interpretation and preconception the user could change opinion about using a chair for its intended function. The author refers in this case to as act biased by intrinsic-control. Extrinsic-control is an affordance derived by the chair in context.

A child might perceive and use a chair in its own interpretative, amateur and playful but goal-orientated way, not in the way the designer intended and in strict adherence to the designer´s instructions, sitting on it, but for instance laying under it or putting the feet high up and the head dangling down. To refer to Bruno Latour´s definition (1992), the chair affords, orders or offers to be used rather as a form of shelter or rather a tool or medium to turn the child´s perspective upside down for a moment, instead of interpreting the chair as a seating-accommodation, or the horizontal-aligned, square-shaped surface for the purpose of sitting still. Within the scope and politics of a chair (and of `chairness´), the question arises who specifies the use, the user or the chair? Does the chair use the actor (for instance, the chair might have the desire to be kept warm, or the wood grains to be stretched by the applied weight and force of a seating individual) or does the actor use the chair to address human fatique? To draw further upon other definitions of affordance (Latour 1992) and perceived affordances (Gibson 1979, Norman 1988), it is the author´s intention to speak through an exemplar of a hermit crab as an actor referring to a study from Jakob von Uexküll (1957). In the following, it is about objects, offering a body cavity in the form of an empty bottle, and the interactive relationship between a hermit crab seeking shelter and the perceived affordance of a non-human animal. As discussed from Latour (1992) in his essay on *`groom´* (*Türschließer*), an able-bodied or less physically capable user entering and leaving a public building and the wall-hole dilemma, the hermit crab is confronted with a similar exigency aiming to dwell and take shelter. As the body size, active motion radius and maneuverability of an (inter)-acting child demands different meanings, functions and purposes to an object e.g. chair, the hermit crab, as a shelter-seeking individual in comparison to a child´s exploratory spirit, the free spirit (*Freigeist*), although much more complex and multi-sensory-layered, insists on a simple functionality towards the shape of objects. The only relevant trigger, perceptual or sensory cue and argument to react and interact with an object, is the presence of an opening to fit into, a cavity to seek temporary shelter. For the hermit crab the object´s meaning is irrelevant but yet solely the interior and exterior formation of material. Within the scope of non-human animals it is the (non-human) actor who acts independently on the affordance of an object. The (non-human) actor recalls actions which can be objectively measured and described as foreseeable pattern of use.

1.3 Door-openers discriminate against very little and very old persons

The previous discussion deals with perceived affordances established by Gibson and Norman. We will focus now on this issue by underlining the implications of physical capabilities of actors towards the negotiation of affordances of objects (introduced by Winner with the term of discrimination). This paragraph draws parallels between the dominance of technological systems and the restricted performances of the cognitive apparatus from users. The subject feeds well into the conception of the research practice aiming at building on an understanding about the requirements, needs and demands of less able-bodied actors.

It is important at this stage to focus, describe and expand the core of the chapter: the world of the user. The world of the user with its diversity and variety of different and versatile needs, requirements, capabilities and so on and one´s implicit objectives, intentions and actions. The author underlines the different and unique experiences, less able-bodied actors might have acting and reacting on the affordances of objects. The sense of human

agency, i.e. the capacity for human beings to make choices, must be reconsidered and reevaluated in its terms as it is not clear how vulnerable actors handle, cope and cooperate with their consciousness (mind and body) and process and develop subjective awareness upon the agency of the physical world. Latour´s work (1992) and his study on hydraulic door-openers as a metaphor for the human interaction with technological agencies, the physical world in general and especially the built environment shows the notion of misunderstanding human needs and discrimination against less able-bodied human.

> This does not quite solve all of the problems, though. To be sure, the hydraulic door closer does not bang the noses of those unaware of local conditions, so its prescriptions may be said to be less restrictive, but it still leaves aside segments of human populations: neither my little nephews nor my grandmother could get in unaided because our groom needed the force of an able-bodied person to accumulate enough energy to close the door later. Latour (1992: 158)

It seems to belong to the duties of an engineer to design for the whole population. Instead of ignoring people with restricted capabilities or non-average human size or strength or those who are unfamiliar to a power-assisted door in a building. Designing a groom for a public building does include addressing diverse needs and requirements such as different capability of users to interact with built environment and react to stimuli of the surrounding or setting. In the case of the *`wall-hole-dilemma´* (Latour 1992) the engineer or the programmer ignored or purely misinterpreted, assuming he or she negotiated informed in his or her decision-making, the way different people will use the product in the real world nor he or she fully recognised different taks and goals people entering the building. For instance - returning to the wheeled suitcase user - travelling at a normal pace it may be difficult for him or her to pull a long-handed suitcase without hindering the door closing and potentially blocking the system.

Winner (1980) discussed the dependency of introducing and implementing machines to the public and highlight the social impact and political consequences on those user or non-user who are experiencing problems. Winner proclaims, 30 years before to the public interest in topic like inclusion and universal design, that machines influence people´s behaviour socially, in public life to a high risk being excluded, discriminated, their lives disrupted and performances impaired, insulted by the inappropriate behaviour of machines or as Latour rendered it as *`nonhumans take over the selective attitudes of those who engineered them´* (Latour 1992: 158).

> […] machines, instruments, and structures of common use - buses, buildings, sidewalks, plumbing fixtures, and so forth - made it impossible for many handicapped persons to move freely about, a condition that systematically excluded them from public life. It is safe to say that designs unsuited for the handicapped arose more from long-standing neglect than from anyone´s active intention. But once the issue was brought to public attention, it became evident that justice required a remedy. A whole range of artifacts have been redesigned and rebuilt to accommondate this minority.
>
> Indeed, many of the most important examples of technology that have political consequences are those that transcend the simple categories “intended” and “unintended” altogether.
>
> [...] In such cases it is neither correct nor insightful to say, “Someone intended to do somebody harm.” Rather one must say that the technological deck has been stacked in advance to favour certain social interests and that some people were bound to receive a better hand than others. (Winner 1980: 125-125)

Referring back to giving objects a form, designing, producing, building and putting them as physical bodies into the world of use, Gibson´s theory of affordances describes how objects are made receivable based on the principles of perceived affordance. Drawing upon the exemplar of a chair-like composition once again, a child reads and interprets the appearance, the image, the Gestalt of the object with a horizontally orientated surface, in

spatially aligned on a certain height relatively to the floor, differently than an adult or dog. Gibson is applying parameters to human factors on which he builds his findings about the size of objects relatively to the size of acting bodies.

> Knee-high for a child is not the same as knee-high for an adult, so the affordances is relative to the size of the individual. But if a surface is horizontal, flat, extended, rigid, and knee-high relative to a perceiver, it can in fact be sat upon. (If it can be discriminated as having just these properties, it should look sit-on-able.) If it does, the affordance is perceived visually. If the surface properties are seen relative to the body surfaces, the self, they constitute a seat and have meaning. (Gibson 1986: 127)

1.4 Hermit crabs, *Frauchen´*s dog and seating-accommondation

Having introduced the relevance of size of objects measured by human size above, it is now important to discuss these issues further by comparing the necessity or demand for comfort, with object size and body size. This paragraph explores new ways of defining perceived cues. Children, as actors, live in their own world and might interpret stimuli in their own specific way. The author draws further from exemplar to underline the renegotiation between objects and its users.

A chair was designed in a specific way and in respect to an adult´s human body and bodily performances. It is play or the primary instinct of a child to climb, and overcome obstacles in order to learn to walk, in comparison to non-human animals who act on their instinct in order to survive. As the child is pursuing a smooth body fit with the chair, or on occasions an unorthodox fit, contact and touch to explore surfaces in physical spaces, the hermit crab has the same notion in mind: To fit into a natural or a man-made environment. The location, habitat or setting is described by Uexküll (1957) as *Umwelt*. The *Umwelt* of a non-human animal is reduced to odor, temperature, tactilty and topography but human animals inherit the ability and own the choice, to live in different *Umwelten* or, according to Josef Pieper, in the Welt (Pieper 1966). The difference between the child´s and the animal´s perceived *Umwelt* is that, nature, through the eye of a cavity-seeking and ergo shelter-seeking animal, provides hundreds of readily available and accessible objects. The child also seeks places to play hide (and seek) but is evolutionary capable of creating, making and building his/her own shelter if the environment lacks of opportunities. Or bottle neck supplied by mankind, reveals to be just handy for the species to be used for the intended purpose and forms a kind of addition to nature´s provided rich tapestry of solutions, each different in size, form and material. In both cases the objects, a chair or a bottle neck offers a three-dimensional pattern awaiting physical contact by their counterparting protagonists, the actors or users. Both animals vary in body size due to age, species, territory or descent and seeking different accommodation with the objects. As the protagonist´s body tries to react physically to the object´s exterior faces, the object itself talks back to the actor (Antonelli 2011) through its surface, structure, texture, flexing and give. The usage of an object is a constant process of adjustment and renegotiation between all parties involved. The hermit crab´s body size varies in performance, look and appearance. Body colour and body substance differ to adapt to the constant change of the environment and the presence of new and well-known predators. To change the scenery of culture to look and investigate technological objects that surround us, children and adults alike, the touchscreen as input device implies an interesting phenomena of exploring complex objects through physical touch.

1.5 Fingerprint on touchscreens, intuition and physical and virtual

This paragraph describes the meaning of a touchscreen, finger gestures and other input devices. The computer screen is a surface of touch on which traces of use are rendered visible, as fingerprints on glass, ready being decoded by an investigator or close observer.

The author pursues the objective to verify traces of use on touchscreens and asks the question if they might reveal extraordinary use, errors in use or even malfunctions. The shelter-seeking behaviour of a non-human animal, which for example can be easily detected by an observer by decoding the path and traces left by a hermit crab in the sand, can be widely compared to the information-seeking behaviour of a human actor leaving fingerprints on a touchscreen. The analogy can be made from carving into granular material to moving forward counter parting the physical notion to carve into the mountain surface of virtual reality (beyond the a rigid flat glass screen). A touchscreen, on an iPad for instance, invites each user in everyday life, through the gateway of a two-dimensional, flat, black surface, to gain access to endless opportunities offered by a number of software applications. The reason why a thin metal block, topped with an even thinner black cover face, has the power to direct affordances to users, to be softly touched, gently stroked and kept in constant eye contact for hours, can only be justified by the attraction and enchantment of data. Lupton (2002) refers to computer interfaces as skins:

> Skins also mediate between users and products in the digital realm. The customized buttons and controls used in computer interfaces are known as skins. Thousands of skins can be downloaded from the Web, allowing users to create and exchange interfaces that are colored, coded, themed, and branded to suit individual whims. (Lupton 2002: 40)

To pass through the gateway into a fortunate, complex and information-rich virtual world, the surface object delegates the user to be a highly sensorimotor-skilled individual, or animal, in order to navigate through the complex rhizome of data. Software designers and information architects reached a high level of intuition for a complex world, even for the youngest and oldest user groups. The black screen which appears when the device is turned off, reveals a rich document of touch caused by the natural fatty film which acts as a separating layer between the fingertips, the hand, the arm, the entire human body network and the face of the technological object world (Meggan Gould 2014). Same-sized imprints, or a cluster of imprints from different users, on the flatness of the screen reveal human touch but are unable to reveal the actor´s relationship to the content, impossible to distinguish a skilled from a disorientated finger. In his practical work the author intended through the creation of three-dimensional surfaces of touch, to compare touch-sensitive data to content and the practical use of objects. The author considered the argument (and reflected the knowledge) that left-behind imprints and traces of use from previous actors affect the behaviour of future actors. Despite being interested in comparing a specific tactile pattern to a specific function, task or operation, the author records the areas of active touch without the knowledge of the actor. Thus it is possible to draw a comparison between a goal-orientated action and handling of the object by tactile touch. The question remains if there is enough evidence, and a clear logic behind the concept, why the size of touchscreen button relates to the size of a human fingertip, and not to the size of a foot, nose or ellbow. The square-sized flat, however designed as a three-dimensional, image implying to be a tactile button with a sensory feedback, reveals to be a lie for the user, expecting a tactile experience similar to a real, non-virtual, button on a radio or calculator, and in particular through the eye´s of a novice and first-time user, who has never entered the virtual world by touch on a flat screen (Norman 1988, Nielsen 1993, Cooper 2003, Rams 2009, Lovell 2010). One can say that the small-scale icons act as buttons and trigger to perform an action only work for small-scaled input devices such as fingertips or other input aids, such as a pen, a fingernail or chopstick-like object. In case a fine manual dexterity might be required to touch icons on screen, users with a limited bodily motions or the ones with a larger finger, might experience problems to conduct the fingertip accordingly. The same problem might occur in the case of extraneous causes e.g. as a passenger in a fast-moving train or airoplane. Both incidents might impact have an impact what is called social exclusion. Of course the touchscreen talks back to the user continuously, via images and tactile vibrations, but the tolerance addressing the needs based on a heterogenious audience is low. The question must be raised why people even accepted the concept of replacing pen and paper controlled by arm, hand and finger, with a body-alienated thing, such as a virtual input unit? In order to provide a widely accessible

tool for non-experts, the computer mouse was introduced to use a machine, navigate through data and enhance efficiency with office applications. Evidently there has been an enormous contradiction in human evolution with technology since PCs took over the market of calculators and office machines. Computer users, disapproving or disfavouring the emerging technology, were forced to use a mouse to work with a screen to complete paperwork with the aim to act more efficiently. A computer mouse (Engelbart, MacLuhan 1964) is not just from the perspective of an usability expert an extremely unhandy, complex and unpractical tool for the job. But in comparison to the established body performance with a similar object such as a pen, the user of a computer mouse is forced to animate a number of muscles, bones and ligaments to move a simulated version of a tip of the ball pen, the cursor in that case, from one pixel area, from one coordinate, to another. Finger gestures, keyboard shortcuts or cursor movements to activate `zoom-in and zoom-out´ have the same effect as changing the distance between the eye and the screen, paper or painting. It has the same effect as changing the distance between the viewer´s eye and the object but those magnifying tools allow the user to sit still and view things as close-ups. Large-scaled icons do work for a universal target group, ergo a wider audience. Thus scale, surface touch and human sizes are interlinked in a meaningful way.

1.6 Presupposition of chairness, object rules and the shift of assumptions

As highlighted above, it is a fact that contact with computers through their skins (interfaces), and therefore experiences with data, is highly dependent on dexterity and sensorimotor skills. We will turn now from this issue to other rules of objects agency by discussing the relationship of a network of objects and its meaning.

A single chair has, for each single actor, a (more or less) pre-set practical meaning e.g. as a tool to accommodate seating or symbolic meaning e.g. material performance simulating zero-gravity. A pair of stacked chairs, vertically aligned, has a different meaning although the meaning of the same chair in the pile remains the same according to the actor´s requirements. A stackable chair (or a pair stackable chairs) if being described in a situation without the presence and the occupation of an actor, insists to be added together and stockpiled due to its specific form, structure, design, pivots and centre of mass. On the other hand, the same chair´s size and shape offers a perfect match or seamless fit for most human actors due to the body-centred design of areas in contact with the human body. The stacked chair´s new or additional or second meaning, although attached with an existing meaning, has shifted or changed from something useful to something useless: from a status of usefulness to a status of uselessness. The actor has a relationship to each single chair and enters another new relationship to a network of chairs, either piled or stacked up or even horizontally aligned in a row of seats in a theatre. To speak in Latour´s terms, the author describes the stature of a single chair as semiotic relationship within `actorship´ and the situation of a chair pile as material relationship between objects.

1.7 Uselessness and usefulness of improvised objects

The issues of the discussion, drawing from Fulton Suri´s and Brandes´ observations, are now the acts of re-purposing of objects and its unprofessional notion. The author summarises here the influences of observational techniques towards his own research practice based on accessing the plurality of data on human condition available in public spaces and domestic homes.

The definition of non-intentional design, formulated by Uta Brandes (2009), and the works of Jane Fulton Suri and Richard Wentworth (Thoughtless Acts, 2005) and Parallel Universies, relate to people´s innate impulses, motivations and attitudes to improvise with surrounding objects, spaces and other physical occurrences and substances. Both works question the meaning of uselessness and usefulness in man-made objects, landscapes, and exploring the human occupation and engagement with substances, material and

ubiquitous objects and things. The works of Brandes, Fulton Suri and Wentworth show evidence, documented by digital ethnography, on how actors use, re-purpose, interact, improvise, adjust and amend firstly spontaneously through change of behaviour on specific events or incidents: change of walking path routine due to a heavy rain shower to keep dry or bypassing hot steaming gully cover to keep out of harm‘s way or to forego a gathering of pigeons. Secondly on how actors do intentionally repurposing objects engaging with material: a folded newspaper or even a party hat folded from it replaces a hat or an umbrella. Above scholars follow an observation technique avoiding actors to „walk into traps“ or to react to artificial, ill-placed, alienated or prepared environment, with stimulus such as e.g. a cultural probe, to capture valid data. It is a concept disregarding the analytic notion and disapproving foreign bodies of research to record human condition. The author acknowledges the chosen path of a social research method disengaging with the setting, the lab, the field, but is during his own case studies convinced, that in order to achieve results, it is out of question to set a framework for studies. His observation technique is based rather on a concept which builds a rigid setting to capture, analyse and understand human condition. The author has considered the aspect of self-imposed behaviour and uncontrolled handling of the probes or tools based on a rather loose relationship between objects and users, but due to technical requirements of the data measurements it became necessary to `calibrate´ the area of contact. This aspect in particular is important in enabling the author to compare human contact visually via mapping of information. As the overall goal of the case study lays in the discovery, investigation and decoding of the real use of objects in everyday commodities. The study attempts to reveal findings on demands, needs and requirements from a wide user audience. It is essential that the deployment of the research practice and the data collection run systematic, reproducible, reliable and verifiable. Aiming at conclusions to be made about the relationship between user behaviour, aesthetics and semantic values of the objects and installation involved. The act of repurposing objects from their intended meaning or function to something of instant and urgent use can be describes as an unprofessional notion or act to design professionally. A non-intentional composition of surrounding things, artefacts or material can be described as a metamorphosis of ready available, accessible objects into a mainly functional however rarely decorative product.

Although it must be argued and further evidenced that an improvised product can be indeed beautiful, desirable and yet consumable. It could be argued that the approach of non-intentional design is practical, material, physical, based on zero or low expertise technique aiming to understand, investigate and solve a problem, or change a situation, through making and doing (Schön 1983, Lawson 1980). Cross (1982) states that the `designerly´ approach on problem solving is purely controlled by synthesis, juxtapositioning the notion of scientists to deal with the problem derived from analysis. Although the author argues that the act of designing - intentional and non-intentional – requires an analytic mind and a synthesising ability. The act of material improvisation, the notion of thoughtlessness are display of design thinking, problem solving techniques and work in progress. The concept of exhibits from creative thinking through prototypes and physical dummies can be described as an attempt from non-experts or non-designers to move into the world of professionals. The author recognises commonalities between the theory of the professional work of a human factors specialist and investigator like Fulton Suri or Brandes, and a detective, a trace analyst or a forensic expert. In order to get results all groups have had the need to acquire eye, ear and skin knowledge techniques to develop the sharpness of sensitivity towards human behaviour and condition.

1.8 Mementos, tape measure, nonreactivity and past behaviour

As discussed above one of the main arguments of Cross and Schön is the power of the designerly approach to knowledge. Shifting this thought now to the work cosmos of a detective, the presence of the observer and the language of wear through use become highly relevant to the result of the „investigation“.

Among other scholars dealing with the discovery of theory through the analysis of data such as Glaser and Strauss (1967), Zeisel (1984), Bailey (1994). Webb (1981, 2000) compares the work and action of a detective to the skill set of an social scientist by underlining the fact that the observer appears on the setting after the behaviour has been completed. There is no direct contact between the observer and the observed enabling the scientist or detective to act nonbiased but putting him into the need to reconstruct past behaviour solely based on physical evidence.

> Considers that the detective, like the social scientist, faces the task of inferring the nature of past behavior by the careful generation and evaluation of current evidence. Some evidence he engineers (by questioning), some he observes (Does the witness develop a tic?), some he develops from extant physical evidence (Did the murder leave his eyeglasses behind?). (Webb et al 1966: 34)

Rathje (1979) pursues a line of thought that the author acknowledges as creating a link from traces of use to the universality of the research method and data collection.

> Material traces are ubiquitous and readily available for study. Trace measures are usually nonreactive and unobtrusive. Since they are applied after behavior has occured they do not modify behavior they seek to study. (Rathje 1979: 78)

As Fulton Suri highlighted through her extensive archive consisting of capturing ad-hoc moments with her camera, it is mentioned the necessity to develop a sharpness of sensitivity to the physical world. Further in order to translate the documents solely from photographs a level of interpretative skill, knowledge and experience about human behaviour is necessary to understand and decode the language of use wear. Arthur Conan Doyle describes the work and action of a detective applied through the use of a vocabulary linking to the notion of body knowledge and engaging with the physical world by the sense of touch.

> As he spoke, he whipped a tape measure and a large round magnifying glass from his pocket. With these two implements he trotted noiselessly about the room, sometimes stopping, occasionally kneeling, and once lying flat upon his face... As I watched him I was irresistibly reminded of a pure-blooded well-trained foxhound as it dashes backwards and forwards through the covert, whining in its eagerness, until it comes across the lost scent. For twenty minutes or more he continued his researches, measuring with the most exact care the distance between marks which were entirely invisible to me, and occasionally applying his tape to the walls in an equally incomprehensible manner. (Conan Doyle 1887)

1.9 Thinking things, embodied distribution and impulse-giver

As underlined above, Rathje´s theory of gaining observational knowledge builds on the matter of time, past and presence. Returning to the materiality of objects, Sutton´s theory of thinking through actions appears to suggest the opposite. The term of categorisation or human conceptual categories is introduced in this paragraph which describes the complex set of the cognitive process. It is highlighted here though that the process of impulses are easier than anticipated: to think things in action.

Categorising things is described in psychology and cognitive science as a notion of grouping things, concepts, thoughts and ideas based on their meanings in order to differentiate. Basically in order to understand the world and to represent knowledge to oneself and to others. Categorisation is a form of clustering or classification and is made and derived from personal experiences and is therefore not universally applicable and meaningful to all humans to the same extent. Categories must be clearly defined, e.g. a tool is a tool, a chisel to carve wood, a car is a car, an umbrella to provide shelter. The discussion above about the detective´s work leads to the objectives of the thief´s work and the criminal intent of actors. The thief must operate in the shadows, act inconspicuously in order not to attract attention, and is obliged and compiled to think about his actions and deliberate use carefully. In material terms the thief needs to avoid leaving traces behind or at least consider leaving misleading traces. Both actions have objectives closely connected to

think and act appropriately and driven by consciousness juxtaposing the argument from Sutton (2008) which is described here. People make connections, in simple and complex object networks, to negotiate between the single or set of objects and their attached meaning, either as tools or as representations. The human body has to negotiate between neural, bodily, sensuous, territorial and social network constraints and conventions. The term of human conceptual categories was introduced by Lakoff and Johnson (1987, Metaphors we live by) and describes the complex machinery of individuals to process information delivered by surrounding objects or systems of objects and received by the human or non-human cognitive apparatus. Malafouris (2004 in Sutton J, 2008) attempts to detach the impulse-giving of our cognitive system and the notion to think through things by means of doing what we are doing, in action. Sutton (2008: 37) highlights this in his paper on Material Agency, Skills and History explaining the embodied and distributed cognition as a key aspect of human social understanding.

> "The efficacy of material culture in the cognitive system lies primarily in the fact that it makes it possible for the mind to operate without having to do so: i.e. ´to think through things, in action, without the need of mental representation" (2004: 58, italics in original). (Sutton 2008: 48)
>
> A focus upon embodied cognition treats human conceptual categories as, to a large extent, dependent on `the bodily nature of the people doing the categorizing´ (Lakoff 1987: 371), rather than corresponding to inherent objective properties of the external reality. (Knappett 2010: 3)
>
> If cognition is distributed as well as embodied, the explanation in cognitive science must often highlight more or less transient extended systems spanning embodied brains, social networks or resources and key parts of the natural and the cultural world. These key parts of material culture are not simply cues which trigger cognitive apparatus inside the head instead form "a continuous part of the machinery itself", as " systematic components the interaction of which brings forth the cognitive process in question" *(Malafouris 2004: 58)*. (Sutton 2008: 37)

1.10 Love and hate of soft toys

As discussed above, derived from Malafouris´ arguments about embodied cognition, the line of thought is now shifting towards the affection actors are able to develop to objects such as soft toys. This paragraph gives a brief introduction to the affection shown by children for soft toys and the notion of redirecting ownership through localisation and change of setting.

Tim Dant (2005: 64) describes *`things as agents of the self but also of the society´* and discusses things towards social relationships to the owners. If we keep focussing on soft toys as things with personality, strong meaning and emotions, it is interesting to read how Dant (2005) thinks about managing those relationships to things, humans are emotionally connected with. He suggests that an affection to a thing can be redirected and made available to others by changing ownership, localisation or setting. The author agrees that children tend to hide, store and place their beloved soft toys at different places in order to show their affection, their love or hate to their belongings. Those actions change the way things are categorised (Lakoff, Johnson 1987) handled, perceived, and how cognition is distributed by stimuli or embodied by touch (Malafouris 2004). A soft toy being put away from parents either after children have `outgrown´ from it or performed as a form of cruel punishment, it creates an even stronger emotional attachment compared to a soft toy that is constantly on display. Storing a beloved and deeply emotionally connected teddy bear in a storage box in the attic and leaving it there for twenty years, will deliver much joy and memories to people who once owned it. The author provides two main arguments for the action involved in putting soft toys away e.g. either in a box or under the bed etcetera. Similar to the previously discussed chair´s attached semiotic and material meaning, the relationship of the actor to the object here has been forcedly changed. Shifted from kinship, intensive love, the desire for embodiment and physical closeness to potentially

the opposite, such as alienation, mediocrity, neutrality and failure of relationship, raised and expressed solely by the change in its spatial arrangement. The act of packing away and putting a lid on a much-loved object, reveals the owner´s or actor´s preservation (or neglect) objective and ends in different meanings: an act of shifting the object´s existence to treasure or to bin. The actor´s role in the usage of soft toys is interesting as the materiality of the specific object reveals its bodily engagement. One can easily read and understand the object´s life just by inspecting the surface displaying or illustrating the very own history. The storage box can act as waste dump, sarcophagus, morgue, showcase or archive and therefore possesses, from the user or actors point of view, a variety of different meanings, from magical moments to situation of valediction.

> Yet, things are also only perceived as magical when they exert agency beyond or against human intentions—when, rather than being passive, inert, and merely material, they do something to us. (Pels 2010: 1)

1.11 Forms of protheses, momentum of touch and scarecrows

As discussed above, one of the main aspects of Dant´s theory on attraction to objects and personhood is loss and the change of ownership. Changing the view angle to embodiment of objects and devices, in this issue Featherstone´s work on body prostheses gains a new sort of relevance. This paragraph connects the authority of Latour´s study of speed bump and the authority of technological environments, such as road traffic and regulatory agencies.

In the case of activating or processing the cognitive apparatus Latour (1999) renders the idea by the metaphor of speed-bump in road traffic and equals the slight change of the surface landscape with a person of authority. The speed-bump as a body extension or simple prothetic devices (Featherstone 1999) of the policeman´s arm, sign or flag symbolising the obligation or order to lower the machine´s power and reduce speed.

> These [forms of protheses and technological systems] range from simple prothetic devices to enhance body motor and sensory functions such as spectacles, to the building of technological environments around the human being, such as motor car or jet fighter, in which the vehicle´s velocity and performance increasingly necessitate the replacement of human sight and motor response by computer-driven vision systems designed to permit greater speed, flexibility and feedback. (Featherstone 1999: 1)

> The speed-bump on the road, to take a familiar example adduced by Bruno Latour, causes the driver to slow down, its agency here substituting for that of the traffic policeman. (Latour 1999: 186)

Therefore the object embodied in a shape of a hillock, formed plastically from asphalt and painted in coloured stripes, acts as a body of subject in the way representing a regulatory body, the authority of the county. In this context to differentiate between objects and subjects, a scarecrow, or in the context of traffic, a representation of a scarecrow dressed in policeman‘s hat and black suit and armed with a plastic bottle for a speed camera (or a representation of a child riding a bike or a pram approaching the road) can act as exemplar to define the object´s stimuli copying a subject´s stimuli to trigger proactive obedience in action.

> In this endless shuttling back and forth between the mind and the material world, it seems that objects can act like subjects and that subjects can be acted upon like objects. (Ingold 2008: 95)

In order to expand on the argument and quotation above, it might be at this stage important to explain action, agency, intention or intentionality attached to objects by referring to Alfred Gell (1998). Actions can be (both), body-motoric movements and thought-making processes. The sense of agency is a term describing subjective perception that an actor applies to execute and control one´s actions derived from the object´s world. Gell (1998)

states that actions are effects from prior intentions. Referring to the exemplar of the speed-bump above it is hard to argue that the road bump itself possesses intentions but one can say that, because speed-bumps are part of a wider (agency) system consisting of rules, constraints and interrelations, they initiate and animate actions. The intention is not self-imposed by the object itself, but directed by external agents, such as its creator, builder and producer. In the event between the speed-bump and the user driving the car, the physical and material engagement lays between objects (non-human agents), the momentum of touch between the asphalt ramp and the soft rubber tyre with its profiled surface.

Conclusion

The key finding from this chapter can be summarised in the conclusion that human experiences with everyday objects (interactions) are attached to presupposition, constraint and rules and are overruled by bias and a higher superior law. Non-human animals act, referring to the statement that *`an animal that operates on a purely reflex plan´* (Uexküll 1992: 359) the opposite. The critical discussion on use, user, using, usefulness and obsolescence of use feeds into the argument of the research practice to measure, and simultaneously observe, human behaviour via a probe simulating an everyday human task (Gibson 1979). The findings that producers of objects, e.g. industrial designers with mass-ware, act, operate and make decisions based on assumptions and interpretations projecting specific use into the charisma of objects. It is no surprise that this attitude towards mass production of objects seems to be ill-conceived and generally wrong as the approach disallows multiplicity of use (Norman 1988), misuse and improvisation by its different actors (Brandes 2009, Fulton Suri, Wentworth 2005).

The critical literature assessment in this chapter reveals the ill-conditioned argument that the `object-actor´ or `actor-object´ relationship is a rigid, two-dimensional interactive path, but a relationship derived from multiple dimensions and crossing knowledge streams, i.e. an object is part of a wider network as is the actor as an heterogeneous member of social contexts. The relationship between actor and object is a constant process of adjustment and readjustment, negotiation and renegotiation, as each element, party and body involved advocates personal stakes, goals and interests. The object is linked to a lobbyist, as is the actor in the social context. The author agrees with Gosden´s (2005) conclusion that our senses are structured and educated by the objects that surround us since childhood, the allowance to use an object without presuppositions seems to be limited, restricted and primarily needs to be authorised by the user´s own, and in most cases interlinked with its social, political and societal power system of norms and values. The author proclaims an extansion of Latour´s argument about the abilities of human agents and (especially) less able-bodied actors in the physical world and underlines the different and unique experiences, „unfit“ actors might have acting and reacting on the affordances of objects. The sense of human agency, i.e. the capacity for human beings to make choices, must be reconsidered and reevaluated in its terms as it is not clear how vulnerable actors handle, cope and cooperate with their consciousness (mind and body) and process and develop subjective awareness upon the agency of the physical world. The interactive relationship between actor and object is not completely covered by literature in case the producer or designer is „unfit“ and might be therefore not fully capable to proceed with physical or cognitive performances. Does this change the presuppositions, rules and decision-making process towards a specific form language, material selection and intended practical use of the object? The traditional hierarchy of the object´s authorities offering, demanding and insisting on the actor to act need to be revised and adapted, not only to take into account emerging technologies and the radical shift in the resulting relationship between object and user, but also to take into consideration that the producer’s interpretations and assumptions about the actor´s behaviour may be incorrect.

Chapter 2

User-object and object-user relationships

Introduction

Chapter 2 on objects introduces the reader in the world of objects, their meanings in social context and past experience (Csikszentmihalyin 1981) and functions to perform, serve and obey their operators and superiors (Godelier 1986, Fowler 2010). Addressing subjects such as human senses, body fit, preconception and embodiment in this chapter, it is closely tied into the conception of the research practice translating mass-ware and everyday objects into agents and story-telling artefacts. This chapter attempts to highlight general questions and enquiries about objects, things, sculptures, artefacts and documents considered from versatile perspectives such as semantics, physics and philosophy. The chapter is focused on the discussion of whether or not the `Sensing Pot´ (research practice) can simulate a document of everyday commodities and how human touch can be measured and understood via prototypes. The reader is introduced here to the Agent-Network-Theory (Callon 1986; Latour 1987, 1992; Law 1999), in the authority of embodied materials (Knappett, Malafouris, Tomkins 2010, Ingold 2009) and cognition defined by Brown (2003).

In the beginning the chapter collects arguments and opinion from different scholars on objecthood and thingness (Heidegger 1971, Schwenger, 2001, Brown 2005, Gosden 2004, Knappett 2008) and compares established concepts alongside works of present design practitioners. The thingness in technology (Winner 1986, Classen 2005) is dealt with later in this chapter. Exemplars of object agency (Gibson 1979, Baudrillard 1995, Latour 1992) and specific object categories, such as the antique and the shift from a practical usership (Dant 2005) to a symbolic ownership are introduced here in order to substantiate the discussion. The significance of the power of human labour and the operation and production of objects is discussed here (Baudrillard 1975, 1995, Winner 1988, Avineri 1970). The discussion of what makes an object different from a surface compound is dealt with in chapter 3.

2.1 Objects, things and documents

Brown (2005) argues that a thing is difficult to define and remains, in fact even if we locate it in a setting, un-nameable. The setting, Gosden (2004) explains, is mainly built and established by social relations. Further he remarks that things are (always) embedded in a social construct and it is impossible to express or measure (them) in terms of quantity. Things offer or hold an *`unquantifiable quality´*. On the other hand, stand objects, as specific items which possess quantifiable qualities and are dismounted from social relations. Heidegger (1971) writes:

> [...] an independent, self-supporting thing may become an object if we place it before us, wether in immediate perception or by bringing it to mind in a recollective re-presentation. However, the thingly character of the thing does not consist in its being a represent object, not can it be defined in any way in terms of the objectness, the over-againstness, of the object. (Heidegger 1971: 165)

Above scholars (Brown 2005, Gosden 2004, Heidegger 1971, Knappett 2008) agree that calling a thing by its name eliminates its thingness. Knappett states that *`Objecthood and thingness are relational registers´* (2008: 144). A thing is determined by its imprecision, its looseness, its versatility in use and its nonverbal cues or an *`abstract from our mode of intuiting it´* (Kant, C1 B307).

Prior to naming a thing determined by its use, comes the naming of a thing by its appearance (Schwenger 2001), location and setting (Gosden 2004). The author considers the act of naming as difficult to call “a cup a cup” solely based on its appearance, unless the act of a specific and intended use, filling with water, is performed. Schwenger (2001) describes further

> Annihilated in a certain sense, the thing is always present in another; unable to appear, the thing is in the first instance appearance. And beyond that appearance, which represents the thing to us as objects, there is an ineluctable presence - the thingness of the thing - that we can never grasp. (Schwenger 2001: 102)

Instead of talking about and applying language and words to things, using things might be more reasonable to define its representation and meaning. A thing will be given its name by using it rather than just being and talking about it. The author proclaims that the practical use, handling and operation of things by actors, and each actor might act differently regarding a thing´s obvious use, transfers a thing into an object, e.g. the thingness into objectness. The act of naming and attaching words to things is applied by each actor differently according to different acts of using. The result is that different names are created for the same thing. Most importantly, with specific usage comes specific naming and the creation and establishment of specific categories of things. The author hereby questions the relevance and importance of misusing things, improvising things and amending the intended use of things by different actors, applying different names to the same thing. To describe the interpretation of a thing, for example an upside down (plastic) cup, might be misread, misinterpreted and misused in function i.e. to cover a bottle neck, a dice on a table or for playing thimblerig. Heidegger (1979) remarks in this context about the jug as a vessel:

> `We represented the effective feature of the vessel, that which does its holding, the void, as a hollow filled with air. […] We failed to give thought to what the jug holds and how it holds`. (Heidegger 1971: 169)

2.2 The aesthetic of simulated everyday commodities

As discussed above one of the qualities of naming or labelling things is the transformation of things into objects and deletes the thingness or shifts categories. We explore now the issue of a simulation of meaning with prototypes. In this paragraph the first link in this chapter to the research practice comes into play. The author uses prototypes to enquiry human condition in a set environment and function-simulating tangible objects. The aim is to gain insights on everyday commodities in use, detached from the interpretation in the context of past experiences. The author considers the applied method as nonreactive and unobtrusive technique to collect data on human condition.

Describing the research practice at this stage of discussion about interpretation of the meaning of objects, the author deliberately abandoned the plan to deploy prototypes representing and serving a common, established and distinct function, purpose, duty or work. In particular the first two touch-sensitive prototypes, a sphere and a circular straight cylinder, are following the notion described above. Thus motivating the user to enquire and raise questions, concerns and preconceptions, such as: What is the solid about? What am I supposed to do with it? Is the object upside down? The author developed a number of material skins for the prototypes, such as light-grey (goat) suede, black and orange cardboard and shiny black plastic film, to let probands engage with the objects in different ways. In the first place those prototypes, covered in brighter colours, were characterised as more lightweight and therefore easier to operate. To the surprise of the author, some probands left fingerprints on the surfaces, due to the fact that these two skins attract dirt. Those marks of use from previous users were used as signs of use for future probands which lead to an interesting change of direction. As the aim of the usability testing was in the first place to render, deploy and evaluate the technological side of the concept, a

nonreactive form language and unobtrusive research method were supposed to be the solution to the problem. An attempt was made to have neutral aesthetics of the prototypes to allow actors room for interpretation of use, handling and operation. The look, surface skin and the semantic image of the prototypes were regulated by geometric solids, vertical lines and a rigid localisation of the bodies. The object´s surface skin became therefore an important feature of the engagement and was designed in such a way - with a smooth, repetitive fabric cover to invite a pleasant tactile experience (affordance).

> When a thing "means something" to someone, it is interpreted in the context of past experiences, either consciously, or unconsciously in the form of habit. (Csikszentmihalyin 1981: 21)

The author concludes that based on the findings from the two initial prototypes, sphere and cylinder, as agents without function and meaning, each solely aesthetic by their geometric shape, the surface skin created the perceptual cue and forms the trigger to engage with the object by tactile experiences (Hara 2004).

2.3 Naming, categorisation and objects of a subject

As discussed above, prototypes can reach a status of holding no meaning or function. Now we explore the popular theory of agency by Latour and Gibson describing objects as parts of a wider network. Further theorising the notion of the research practice the author refers to common scholars (Brown 2003, Knappett 2008, Schwenger 2001, Latour 1999). Keywords, such as sensuous cues and perceived affordances, play into the the practice-led research and the shape of the computer-enabled matrix of the `Sensing Pot´. The author argues that an object created "free" from universal preconceptions, however this concept is speculative and debatable, is prone to produce a wider pattern of user touch.

Knappett (2008) proclaims, referring to Bill Brown´s key statement that `cognition overrules the senses´ (Brown 2003), that human interaction with things and object is controlled, overshadowed to put it into a more darker sense, by preconceptual cues derived by our liability to objectify, categorise and stereotype things and attach certain meanings to objects. According to Uexküll (1992) and Gibson (1979) specific visual images, created by a static silhouette or one in motion - predator-prey relationship - demand and arouse specific human actions, however Norman (1999) claims unpredictability of those triggered set of actions. Referring back to industrial design, physical things and the natural relationship between the real world and users or an animal and the `actant-actor´ relationship (Callon 1986, Greimas 1987, Latour 1987), it was the author´s intention to question constraints and conventions, bodily (anatomic model) and perceived (sensory and neural system), towards perceived objects. Although the Sensing Pot lacks of a clear defined and communicated visual attached to the object´s meaning e.g. a handle, grip hole to manage pouring water, it offers a logic action, but further opens the debate for interpretation and invites the user, reading the cues, to negotiate within the process of categorisation in material culture. The notion of naming (or labeling in some sense) takes an important part in the act of categorisation within the world of tangible things. The author agrees generally with the argument from Knappett (2008):

> Naming something with a word can make an object out of a material thing and the same is true of imaging: the image of a thing can transform it into an object. In other words, things in the material world are carriers of potential information and it is their link with concepts that do carry significant information. (Knappett 2008: 223)

The author acknowledges the description that naming something with a word makes something into an object and *`nullifies its thingness´* (Knappett 2008).

> [...] The word denies thingness in much the same way that the image does. In both cases, a process of categorisation means that we close ourselves to things.´ (Knappett 2008: 145)

And considering Schwenger´s (2001) argument that the process of naming of a thing leads to *`the murder of the thing´*. He describes further

> […] things are re-created in words but that things become objects - objects of a subject, of a subjectivity that language both expresses and […] forms. Language, according to Heidegger, is an inherent part of human subject; but there is no language in the being of stone, plant, or animal (see „O“, p. 73). When such a being is named, then it is also changed.´ (Schwenger 2001: 101)
>
> If there is a murder of the thing by the word, then, this does not definitively annihilate that thing; it only transposes it to the scene of an interminable haunting of language. (Schwenger 2001, 113)

Gibson (1979) describes the agency of on object in the visual perception, the visual image apprehended by sight, as what the objects affords and offers to the user. Latour (1992) provides a juxtaposing definition focussing on the object as an inherent less isolated character. Latour and his colleagues and scholars define the meaning of an object as part of a wider network, a systems of other objects, agents, actors, human and non-human animals.

2.4 Soft toys, parental punishment and heirlooms, objects as possessions and slaves

Shifting the discourse from the discussion of the meaning of objects to material evidence and Dant´s theory of tools and heirlooms. This paragraph shifts the discourse from animal behaviour, perceived trigger and instinctive set of actions into the sphere of home cultures and children behaviour. The author questions the theory that humans are educated only in childhood. Due to the rapidly expanding markets (into new territories) and the emerging world of unprecedented objects, human continue being educated not just in childhood, but ongoing since childhood.

To complete the picture from the personal relationship of children to their soft toys, in particular dolls, the author presumes that the image, as an archive of use, documents if a toy or doll has been loved, disliked, disregard or even hated. Dant (2005) writes about object´s rights and feelings. If it seems to be the case that toys, dolls and teddy bears are used as tools to (re-)direct strong affections from humans (parents or caregiver) to material object - instead of human or non-human agencies (or referring to Anthony Synnott, 2005, describing the case of the close physical, parental interactions as counterpart to the potential lack of mother´s warmth), there is material evidence for this kind of relationship between a child and its toys. If referring to Gosden, where we learn and being educated by the objects that surround us in childhood, it is highly relevant that we do leave traces, imprints and marks on used, touched and loved or hated objects. To expand and ideally complete Gosden´s demonstration of thoughts on objects in childhood it is more accurate to state that it can´t be purely the case to reveal the meaning of objects that surround us in childhood. It is rather relevant to acknowledge the presence and describe the tools, we handle, use, interact and operate (and refuse, dismiss, avoid) with in an early age of development. Aspects about how we talk to, use, act on and touch object tools and how they talk back to us: firstly through their aesthetic, semantic appearance, shape, colour and form, intended meaning, function, task, orientation, function and purpose. Secondly the influence and the impact of the traces on the child as actor, user and partner and companion for life, caused by its use, handling and operation and also misuse, damage, autopsy, dissecting, surgery, repair - as a summary how can traces of use tell a story about treating soft toys as love ones, ghosts or slaves. Dant (2005) acknowledges the status shift from pure tool objects to objects of deep attachment, such as heirlooms, gifts and souvenirs or object that refer to a certain ritual or situation, e.g. a football shot into the crowd, a symbolic rubblestone or the first trophy). From the author´s perspective analysing traces, imprints and marks on children´s soft toys would provide insights on how the material objects has been used, dealt and interacted with over time since childhood, if

those tons of soft toys resting in storing boxes in the attics could be included - as a form of preservation of childhood activities and memories. If the relationship, both positive and negative ones, between toys and children can be recorded and documented in material surfaces, what is the meaning of scars? All those intentionally by children caused mal- or illtreatment, endurance tests and misuse of soft toys (surgeries: if a soft toy is regarded a dead body - teddy carcass from its owner/user), the haircut session, the removed eyes and all those unintentional bruises, aches and pains produced by extensive and extreme use over long period of time.

2.5 (Wrapped) Duct-tape as document of human condition

As described above one of the implications of Dant´s theory of childhood memories with objects is the shift of affections. Turning attention to the documentation of use, display of history, and later to Knappett´s theory of the Agent-Network-Theory (ANT). This paragraph questions the rules of use and enquiries if traces of use might impact and influence the way user deal with objects. It is argued here that an human act caused unknowingly and non-intentionally, in comparison to intentionally use, sets rules of amateurism. The author concludes that unprofessional interaction as derived in ad-hoc moments can have valuable insightfulness into human condition.

Gosden (2005) offers a set of answers to the question of the potential interrelationship between users and objects. He argues in the paper `What Do Objects Want´ in the Journal of Archaeological Method and Theory that things have effects on people and *`that an object to be socially powerful in a recognised manner, the form of the object lays down certain rules of use which influence the sensory and emotional impacts of the object´* (Gosden 2005: 193). Gosden writes about culture, and the significance of objects or networks of objects in the social context. The more relevant question, risen from the author´s point of view, is to explore how visible and recognisable traces of use or other signs of use can have an effect on how people use on object or environment. A worn down grass patch on a football pitch tells a story about the physical extremely and persistent use of one user or user group, over a long period. But at the same time it can be read as a sign of use from a set of users, over a short period of time - such as a mass use. These forms of collecting material evidence, tracking of e.g. a ruined turf, can be obtained to gain an understanding about the history of the setting.

A repaired object, for instance a duct-tape wrapped steering wheel of a car, can have an effect on how people touch, use and steer and drive the car. A plastic garden chair, with a similar repair technique, can have an impact on how people sit on it, presuming that due to the fact that a duct-tape wrapped leg symbolises material damages and respectively weakness, the user would possibly take the time to think about the operation and handling of that object and the use of it. The chair as a repaired, ill object gains a superforce with a greater resulting affect on the user´s behaviour than a chair without any document of use, without the display of a particular history. Material defects, if visible to the user, tell a story - a story of precaution, an alert phase and subtle risk-assessment in order to avoid harmful action: sitting down and hitting hard a weak-legged chair. Agents, in the form of a human or non-human user, produce legacies and mementos through physical touch of material objects. In the context the set of action can cause, intentionally or unintentionally, some form of traces. By physically touching an object it is difficult not to leave a single form of trace, evidence and exhibit revealing past behaviour. Referring back to the relationship of the actor using a chair thoroughly discussed in chapter 1, the author highlights the chair object from a different angle, from the perspective of an object as an item within a wider network of objects. At this point the author builds upon a construct Knappett provided in the paper `The Neglected Networks of Material Agency: Artefacts, Pictures and Texts´ (2008). Knappett describes the agency, following the Agent-Network-Theory (ANT), as a process of collectives between humans and non-humans and provides in this context an exemplar of a *`Trimaran-operating passenger´*. He questions the interaction between

the ultra-modern sailing boat and the upon-acting yachtswoman and concludes that the non-human actor (the Trimaran) achieves all the results concerning the act of sailing. The agency of the human actor (the yachtswoman) is reduced to a minimum due to the fact that only none or minor actions are in demand to function the boat. To imagine the chair shall be an integrated part of the object network, duct-taped onto the deck forming a physical bond between the boat and the chair, as a support structure for a human body and seating-accommodation, it adds no meaning to the function of the boat thus there is no need for the human agents to act.

2.6 Artifactual aggregation and object networks

As the impact of the agency of an human actor is highlighted by Knappett above, it is now time and place to focus on object-specific characteristics of material (from popular objects). This paragraph is about the artifactual elements acting together to form relations between relations of objects. It is important to understand that objects work together with other objects (a network of objects enabling a boat to sail or a bike to travel uphill). Some objects gain in importance because of the presence of other meaningful nearby objects. An object displayed in a museum behind glass enhances the value of others next to it. Further the interrelationship of the physical involvement of the human and the artifactual apparatus is explained. Clarke (1978 - in Gosden 2005) argues that artifacts and in particular sets of types of artifacts (Clarke calls them artifactual aggregation) are produced by *`repeated set of actions´ but then cause `repeated sets of actions implemented by the type´*.

Touch, handling, use and operation of objects demand muscular effort and strength. The swoosh of a fingertip to unlock smart phones, to a minimum or to more extent, riding a bike. But prior to the existence of ready to use object, human muscles have been in demand to make things, to form and shape a material, or at least, operate machines. Gell (in Gosden 2005) also suggests the idea to discuss the impact of the material world on to how it affects human relations. Let us consider a specific chair, the Thonet No. 14 bistro chair (praised by many architects including among others Le Corbusier), is a well-known, omnipresent, popular and established object, at least in the world of man-made objects since the early nineteenth century. The popularity can be explained by the success to (de-) form solid wood into a three-dimensional ribbon-like rail, kept solely in position only by a few fixtures point creating a rigid, lightweight and aesthetic product (and with its manufacturing technique comes an attractive purchase price). The author proclaims that the No. 14 mythological notion exists only (or mainly) by its materiality. Its specific fibred straight grain texture (run), natural colour, coarse surface haptic and acidly smell. The latter aspect occurs not in the final product, but in the workshop when beech is processed; cut, sanded and in particular steamed. The odour remains if surface is left untreated). No. 14 was a ground-breaking exemplar of design due to its entire transparent silhouette, and revolutionary as a response to the trend and taste of the population at the end of the 1800 century. Materiality becomes the main argument for receiving (and responding to) perceptual cues and the effect cannot be separated from the object, i.e. even by the effort to replace the steam-bent beechwood with something else, such as an aluminium tubing (with the same diameter) or cast in Epoxy Resin for instance, the appearance of the chair remains similar but distant and far from the same. The core aspect of No. 14 is its materiality propagating, although undeliberately, a powerful semantic image and has further use and purpose-related and object-specific characteristics. These qualities underline the uniqueness and authenticity of the object: the flexibility of the structure whilst sitting, the featherlight handling, the gently-smooth gesture inviting an actor to interact and even the unique sound in the case of scratching the leg ends over floor tiles. The material(istic) attributes remain attached the original bistro chair and cannot be translated by other materials. Nevertheless the author agrees that the attempt of replacing the material, following the regime of maintaining the form and shape of the object, can be an effectful notion to crosslink or reevaluate established meanings to popular objects. Gosden (2005) writes further about the potential will or intention of an object in terms of what does the object want (from its user) and not vice versa as designers for instance may

think. It seems the notion appears that objects act like persons and I may go too far to argue that objects do inherit a kind of personhood (Godelier 1986, Fowler 2010).

2.7 Agrarian work, labour and disembodiment by machines

Following the implications of making (of classic design pieces), as described above, and special manufacturing process and material properties, we turn now to Winner´s theory of agrarian work and the politics of artefacts. Referring to the production and personhood above and earlier, the process of steam-bending wood is a labour-intensive attempt to bring man-made objects into form. The attempt to tame a generally hard to manage material such as wood, from a deeply-rooted, entrenched, possibly twisted, tree into a number of accurate circular-profiled timber slats, is a process demanding in part machining but also mainly professional hand skills following a rigorous process to achieve an immaculate serial product. The act of production reveals to be a key aspect for personhood as the process demands to touch and work with the characteristics of the material. Referring further to a passage in Baudrillard´s `The Mirror of Production´ (1975: 25):

> The definition of labour power as the source of `concrete´ social wealth is the complete expression of the abstract manipulation of labour power: the truth of capital culminates in this `evidence´ of man as producer of value. (Baudrillard 1975: 25)

Engaging physically with the material, and in particular its surface, by cutting into it, joining it together with contrasting materials such as the cane or palm fibres etcetera leads to an embodiment with the object. Making a chair, or to lesser extent purchasing a hand-made chair (created and built by a specific person or famous sculptor, artist or architect), builds a close relationship to the object. The phenomena of a relationship to an object, based on knowing that somebody spent a huge amount of time in building it, and further has put blood, sweat and tears into the process (especially by steaming long slats of beech), differs from a relationship to mass ware. Mass produced objects are based on virtual data and do not allow the builder to interfere with machines or material. The same network of objects working together is described in the next paragraph, discussing the relationship of machines, as network of objects, and mass-use by labour. The main argument here is that the machine-process disembodies human engagement with materiality.

Winner (1988: 25) describes in `Do have artefacts have politics´ the system between producers of machines and those who need to use, operate and work with them. By describing the network and the agency-network-theory (Callon 1986, Latour 1987, 1992, Law 1999). Winner connects aspects between physical, full body contact labour and agrarian work and questions the ethical responsibility of those designer or engineers who develop machine to boost crop yield – but *`on the back´* of saving labour (Avineri in Sahlins 1976), landscape and earth. The technological benefit of new machines such as a mechanical tomato harvester (Winner 1988: 26) have been invented to save physical hard labour and increase crops but not intended to do *`someone else harm´*. There is always the matter of choice and to make decision to use or not to use a tool, machine or object.

> We pre-suppose labour in a form that stamps it as exclusively human. A spider conducts operations that resemble those of a weaver, and a bee puts to shame many an architect in the construction of her cells. But what distinguishes the worst architect from the best of bees is this, that the architect raises his structure in imagination before he erects it in reality. At the end of the labour-process, we get a result that already existed in the imagination of the labourer at its commencement [i.e., had already pre-existed ideally]. (Karl Marx in Avineri 1968)

If human labour power is an activity of time-consumption, (and sheer waste of time) and generally observed in public as negative and to be avoided, nature can provide counter-example. In industrial production saving labour power is considered as a concept of intelligence and since the introduction of advanced technologies and additive manufacturing a feasible and most reliable method to produce and distribute mass ware for

consumption. Capital goods such as an efficiency-orientated harvester, a rapid printing or metal press, an assembly line or an injection moulding die are investments into machines, tools or a sort of a logistical mean to economise parties involved. The machine-process, by juxtaposing the labour-process, mediates to replace, single out and disembody human engagement with materiality and foster the concept of investing into machines rather than labouring man, social benefits and family allowance.

2.8 The gate to the abyss

The making and production of machines, as introduced above, excludes the embodiment of the actor (the labour-man or worker) with materiality, highlighting the issue of the evolution of shape, surface, size and scale of objects in relation to the consistency of the human body. In this paragraph the reference has been made between the human body and the size of machines. The keyword of scale is discussed with reference of a human fingertip as a medium to interact with the virtual world. It is argued here that the criteria of ergonomic fit is also the criteria of acceptance of an object. For further reference to this topic coping mechanism need to be involved in the discussion which humans apply to engage with ill-fitted commodities. Returning back in the relationship between humans and their surrounding objects, the size in relation to the human body, its extremities and limitations has an impact on how objects and environments are interacted with. Naturally a hammer does vary in size to fulfil specific tasks and there is little doubt that different sized hammers can be used by the same human beings. A specific hammer does not generally refer to a specific worker, gender or group of people. Rowland (1964) describes the shape of tools by revealing the honesty of the shape expressing their function.

> The development of the axe in different parts of the world is another example of how similar shapes evolve as the result of similar purposes. […] This is rather like solving a mathematical problem in a number of different ways and getting the same answer each time: it proves the correctness of the answer. (Howland 1964: 66)

Relating hand tools, such as an axe, a hammer or a pair of pliers, to human factors, the scale of the surface and relationship to the scale of the human, in particular to the hand, finger, cheek, feet or lips and tongue, is key to the sense and experience of touch. The inside of a ceramic cup might feel smooth touched by hand, but it could feel coarse and porous if licked by the tongue when drinking tea from it. The texture of the inner surface of a metal watering can, which might be galvanised, dictates, although quite subtly, the way the water streams out of the nozzle. Walking upon a freshly cut meadow (or a sisal carpet) bare foot provides the impression of softness, viscosity and density. On the other hand, using the cheek or forehead to touch the same surface, might lead to quite the opposite experience: `thistly´ and painful such as a Fakir laying on a bed of nails.

Considering the major developmental steps in the area of digital technology towards `down-scaling´ and miniaturising objects, the issue of touch and surface size in balance to human body sizes must be raised. A few years ago, mobile phones were relatively drastically reduced in size due to advanced technologies and smaller components (batteries, power processors and so on). After mobile phones got larger, not due to processors or battery size, but due to the rise and introduction of touchscreens and enhanced transmission rates enabling users to watch movies on-the-go and do diverse other screen-related visually demanding, image-based tasks. People still use their fingertips, as the size of a human thumb remained constant, in a complex and in a high-skilled manner, to control what is going to happen on the screen (despite the use of voice controllers, hot-keys and VIP short-cuts enabling users to bypass complicated and time-consuming input patterns). Technological objects shrunk to a minimal spatial size, and thus external surfaces and interface are obliged to offer a small area for physical touch with the outside world. Most smart phones, however more complex in software applications, and features, are designed for very small fingers and high-skilled fine motor skills. It could be argued that there might

be a connection between easy-to-understand, user-friendly and intuitive human computer interface and the child-finger-sized keyboard on touch screens.

2.9 `Chairness´ exemplified

The relation between the size of the object surface and the size of human skin is discussed above. We are now turn to the Uexküll´s argument about the meaning of objects and Knappett´s theory of the *`image-schema´*. The paragraph deals with widening the discourse of object meaning derived from personal and shared surrounding, perceptual cues and meaning of reshaping the image-schema.

In broad terms, the author locates that the user is educated, knowing and decoding a random stimulus, an image-schema, such as a horizontal surface, as an object to sit on. It can be argued that people might be able to define the function of a chair by touching it, without knowing that a mainly chair exists in order to sit on it. Uexküll (1992) proclaims that there is more function, use and meaning to a chair rather than supporting the posture, *`A chair occasionally be used as a weapon´* (Uexküll 1992: 358). In terms of defining the functions of a chair it can be argued that the chair deserves to act more generally: a simple shift from standing instead of sitting or laying underneath the seat for instance. Referring to children´s engagement with objects as extreme users, a chair is used for everything rather than just sitting on it. A chair offers different meanings to different people. The Tulip chair (Verner Panton) was, when introduced to the market in 1955, a statement of unique, novel and advanced material and manufacturing techniques and the Wasily chair (Model B3) to a similar extent gave an impression of gaining a victory over the stubbornness of steel tubes and surface corrosion. It can be argued that the primary meaning of both examples is not the traditional use of a chair as seating-accommodation, but rather an object of desire, a status symbol to express an intellect, represent high educational standard and underline the arrogance to purchase, own and present a chair ignoring the urgent need to use it to support seating. The visual image of two ordinary chairs stacked onto each other changes the inherent meaning from a single chair as a single seater drastically from an object with a clear and primary message to a set of objects (a composition of similar mass-ware) communicating an inactive storing unit. It could be argued that two chair offer seating-accommodation for two people depending on the way those two objects are composed, aligned and spatially related to each other. Although the meaning of two separate chairs remains the same in theory, but in the case they are piled, lying upon another, interlinked, interwoven the meaning of the conglomerate is different.

2.10 Engagement with clay, plants and bushes derived from felt experiences

It was underlined above, that, derived from Uexküll´s theory of affordances, a (simple) object, such as a chair, (comes with and) offers multiple solutions of use. We shift now our attention to Ingold´s theory of the authority and the power of embodied materials. This paragraph refers to the discussion how materiality and texture can foster and enable an engangement (or disengagement) with objects, nature and the built environment.

In contrast and dichotomy to the form language displaying high-tech, velocity and precision by applying shearing machines to aluminium blocks, plastic clay stands at the other end of the spectrum as a soft, formable and patient material. By material engagement with the medium of clay, for instance a pot or a vessel, as pure functional item can be the result, on the other hand clay is used to form clay figurines (Knappett, Malafouris, Tomkins 2010). A practitioner forming clay from primitive nature and substance into a resilient, ductile, non-reversible and durable solid, demands knowledge, mechanical hand skills, tactile and sensuous understanding of the homogeneous material.

> Likewise the gardener, armed with spade, fork and trowel, has to struggle to prevent the garden from turning into a jungle (Ingold 2009: 94)

The authority of both embodied materials, involved processes and act(ions), clay and plants, lay in their adherent characterisation of impatience. In case the potter stops adding water to the clay, the material dies, as do seedlings who need the sun and water in order to grow. Different materials, surfaces as well as objects offer different plastic experiences, causing joy or grief and moments of happiness or sadness, calming or stimulating. Although it is impossible to separate the meaning of materiality from the meaning of the objects due to the fact that they only exist together as a form of symbiosis to benefit each other. The meanings of a material colour, texture, temperature and form (Rowland 1964) have each a meaning of its own (one a different one with the aspects combined), but less powerful in their affordances and with weaker perceptual cues. Some objects are staged just through the choice of firstly surface look and secondly surface touch dominating the object´s affordance. To foster a discussion on the authority of materials and the two given examples, clay and plants (flowers, bush or tree), it might be beneficial to add two more, plastic and wood. It might be impossible to single out individual preconceptions encountering materials. Actors might bring defined interpretation according to materials to the table: one might prefer to touch a wooden chair connecting to its scent rather than haptic, another might prefer to lay a hand on a bowl made of clay suggesting the material´s ability for deforming, a third one might lift a plastic bucket (Morello, Castelli Ferrieri 1984) thinking it must be featherlight or as against a metal coated flower pot (Stewart 1979) must be heavy and sturdy. Those acquired presuppositions are different from actor to actor, culture to culture, time to time. To conclude here it can be said that there are similarities in engaging with materiality: grabbing or picking a flower for instance are common behaviours triggered by the (omnipresent) beauteousness of flora, touching flat against a wooden bowl with the palm of one‘s hands might be similar behavioural pattern stimulated by the emotional closeness to trees

2.11 Allowance of the object`s space, its locality and `image schema´

As discussed above, the two meanings - of materiality and object - seem to be inseparable. The next paragraph discusses the issue of human senses. The author provides here references to his research practice on human senses, perceived affordances and information-processing from multiple senses. Human senses and materiality are well discussed in literature by Renfrew (2004), DeMarrais (2004) and in particular with the works of Gosden (2004, 2005).

> The nature of social being for people will be structured by the education of their senses by the objects surrounding them in childhood, giving them a series of stances and presuppositions towards the world derived from local material culture. People crystallize out in the interstices between objects, taking up the space allowed them by the object world, with our senses and emotions educated by the object world. (Gosden 2005: 197)

In order to read and understand the stories in surfaces, surface compositions and objects, preconceptions come into play. Is the vessel a tool? What for? The outer skin with its specific shape describes a narrative, introduces the reader into a story, tells the user where to put it, how to place it and what to do with it (Gosden 2005). Referring to the pot or vessel, questions to be addressed by the concept of perceived affordances (Norman 1999) can be: Does the cone-shaped appearance own an intended, preconceptual authority, a limitation or even a certain rule book or guideline?

> An image schema is a recurring dynamic pattern of our perceptual interactions and motor programmes that give coherence and structure to our experience. In particular, according to Lakoff and Johnson, image schemes: (a) are directly meaningful preconceptual structures, which arise from, or are grounded in, human

> recurrent bodily movements through space, perceptual interactions, and material engagement, and (b) integrate information from multiple senses and operate beneath conscious awareness, prior to and independently of other concept modalities. (Knappett 2010: 3)

Relating the theoretical discussion on actor-agency-networks (Latour 1992, Law 1999), perceived affordances (Gibson 1999) and tactile stimuli, the author intended to explore sensory and perceptual cues, to use terms borrowed from psychological and cognitive science, by conducting case studies on usability problems (Nielson 1993) in practice.

2.12 The abstraction of a vessel: the Sensing Pot

As discussed above, one of the main implications of Lakoff and Johnson's theory of preconceptual structure is the application to information-processing using multiple senses. We turn now to the (most) relevant aspects of the touch-sensitive prototypes formulating the practical development of the thesis. This paragraph introduces the reader into the concept of the Sensing Pot, a container covered in a computer-enabled fabric eliciting data of touch, (explicitely) in greater detail. The main argument here is to evaluate the development of meaning-free and value-free test objects avoiding centers of common touch i.e. grip, handle, button interpreted by past experiences.

The author developed a series of objects, based on a simple, geometrical form language, addressing a wider and broader user audience. The objects work through the medium of containment by representing a level of product abstraction of a vessel or a pot e.g. to hold a liquid. In order to link theory to practice at this point of the critical analysis and evaluation of the literature studied, the author describes the final prototype, a vessel, the Sensing Pot to the reader at this stage again in more detail. The Sensing Pot, a cone-shaped container, built by a circular rotation, of exactly 300 mm height, with large fillets at the base and a clear cut at the top end, has two oppositely-aligned spouts offering two similar openings to the body e.g. to fill, empty and refill with fluid or a simulation of liquid-like particles. In order to investigate a wide range of bodily and sensory experiences with the object, the author avoids obvious representations aiming at a central area of tactile contact e.g. handle, grip, grip hole et cetera (aim: absence of triggers to perceived affordances), hoping to observe and capture diverse, unexpected, unorthodox and creative patterns of points of interaction between actor and non-human agent, the Sensing Pot. The decision not to provide technical aids to use the object, as a tool to fulfil a task, is led by the approach not to dictate, guide or control interactive strains of use, following the fact that the audience is diverse, able-bodied or less able-bodied; male or female; young or old, and demands a versatile contact points of interference with the object. Similar to the presence and dominance of handles, grips and grip holes, as pre-conceptualised, preoccupied with agency, biased, suggested interfaces of human contact, text or symbols on objects can, although the author thinks to a weaker extent, have a similar influence on human behaviour and the actor-subjects relationship. The keyword which comes into play is the process of categorisation as described in chapter 1.9 titled `Thinking things, embodied distribution and impulse-giver´.

2.13 Au pair girl accommodation, traces and loss of history

After having introduced (the reader) into the evolution of the form language and the aspect of materiality of the prototypes in practice, it now seems to be relevant to refer to Miller´s studies about consumption and redecoration of furniture and fittings (in rental properties) and the important factor of time relating to traces of use and surface history. In this paragraph the author continues to refer human condition to physical traces as a form of document history. The engagement with materiality in domestic temporary accommodation is a key aspect of attaching meaning to objects, just as collecting objects

is key to the concept of connecting the past with the present. Another key point is the subject of time, as the referenced study about the human condition of au pair girls and their rooms in private homes, tells us, is important to produce physical and traceable signs of occupation. The material properties as the quality of the making are relevant indicators to store mark-making. Miller (2010: 85) describes identical kitchen fittings in rental properties and the tenants' behaviour.

> So you could imagine this population as artists. Each is presented with a blank canvas - a white kitchen surface. After thirteen years, at the time of my study, what had they painted onto this canvas and why?

It is not the painting job or the desire for redecoration the author is interested in it is more the way the material has been wearing down, damaged or changed in shape or form by more or less intensive use over time. One can describe the change of the material surface as unintentionally altered and changed, as this may be caused by everyday use in the kitchen because it is not created with intention. Fulfilling a task on the working surface kitchen top, such as placing a hot pot or pan repeatedly on the surface or cutting a loaf of bread directly on the kitchen table, are actions which can be read as traces of use and actions as a reliable source of information to understand the user´s interaction. Both examples can be a used to discuss one of the main research question on the impact of a product or surface history, the consumption of cheap, spatial disposals and the erasure of personal traces of use. The information-rich tapestry inherent to the visible, facing, blank skin of the furniture and static objects the occupant has created could become a feedback-giver to estimate what realistically, authentically happened behind closed doors. Referring to IKEA furniture design and their inherent low quality appeal and liability to come unglued in use, leading after a short-term use to the need for a replacement. Traces of individual use and misuse, surface treatment, modification and personal marks and messages, are instantly erased rather than preserved ready to be investigated by the host or the trace analyist.

The author intends to restate at this stage of the critical analysis the correlation between the Miller´s passage above describing the (historical) value of the fittings in private rooms and Mouto´s discussion following on artefact collections from an area hit by a tsunami. The essence of the comparison lies in the material(istic) form of the occupant´s document. The mark-making on a surface of a bedside table, for instance, derived from an au pair girl (in love), or collected and displayed objects with sentimental value are a group of artefacts evidencing human occupation. Assuming that IKEA furniture is low-quality leads to their frequent discard, replacement and refurbishment of rooms. Subsequently all human evidence is erased. A tsunami-affected village experienced the same concept of erasing human documents, but to a larger extent. Mouto (2007) describes the importance of artefacts and underlines the loss of history and human, cultural archive caused by natural disaster, such as tsunami and an aftermath of the wave. It is a bit far-fetched to draw a comparison between the urge to re-furbish and clear-out furniture and fittings, prior to the arrival of the next au pair, and the destruction caused by seismic wave, but the aspect of preservation and conservation of used artefact is in both world with different degree of damage, relevant to documenting human life - one short, one long. Mouto (2007) describes a group of people of a community who presented artefacts in a National Museum after and before the Aitope tsunami has hit the coast of Papua New Guinea. Based on ethnographic collections made through fieldwork carried out in some of these affected villages, members of the Department of Anthropology within the PNG National Museum decided to stage an exhibition to recall the people and the villages that were claimed by the tide.

> Some of the ethnographic objects and photographs in the exhibition had been collected before the event, while others were taken in its wake. [...] They also showed how people were trying to cope and readjust to the changes brought about the tsunami. This was true not just for those who lost their loved ones, but also limbs, homes and possessions. Many had re-establish their villages in new settings away from the beachfront.

> The fact that previous au pair girls or boys might have missed the opportunity to leave traces and signs, hidden secrets, messages that were otherwise concealed for decades, to transmit, circulate and exchange information with their replacements or followers. The lines of communication are interrupted and hidden information might be lost. By erasing artefacts of preoccupation of a person, a previous au pair, is deleted and it appears that the person had never existed. There is no physical evidence or proof of the girl´s inhabitancy because personal things were not collected for preservation. Mouto A (2007: 95-96)

2.14 The sense of things, collecting and display

The implications of mark-making, based on Miller´s and Mouto´s theories and findings, have been discussed and compared above, and the discussion about durability and disposability finds a rather complete end with Brown, Miller and Baudrillard describing the meaning of and affection to antiques, as a rich source of information about consumer histories. This short paragraph is referencing two popular scholars and introduces the terms of durability of physical room fittings and highlight the fact that disposables harbor an information-rich unit to tell stories about inhabitants. The issues of preservation must be raised as disposables are usually not prone to be kept as documents.

> But the effort to sell things, to purchase things, and to accumulate things had an inevitable result: " We realise that we do not possess them; they possess us." (Brown 2003: 5)

Brown´s key term of purchasing things above is explored further in the next passage. The white melamine faces of furniture comes with an authority of its usage, either make the appeal to the users not to physically engage with it, e.g. use pen, blade or hammer to immortalise themselves or the opposite in the form of keeping one´s distance and staying well clear of it. Miller (1998) projects an unforeseen intellect above the average consumers, DIY labouring man and budget-motivated and loan students of cheap fixtures and overrated themselves by arguing that they would consider psychological effect when collecting physical objects and reflect (pro)actively on their buying decisions. Thus Brown (2003) draws a more realistic picture by describing the consumers´ naivety, cluelessness and disastrousness when it comes to reaching an ad-hoc decision on taste, budget, fitting accuracy and localisation of objects.

> Collecting had become one of the topics of the day, but the psychology of collecting generally boiled down to a universalizing anthropology. [...] the collecting instinct is "practically universal"; the apparently spontaneous development of the collecting impulse testified to the fact that it is *"no merely acquired trait"*. (Brown 2003: 163; in italic Burk 1907)

The act or notion of collecting things as mythological objects or objects of personal desire is related to time, a consumption based on the present and past. Baudrillard (1996) describes the antique as an object of *`immemorialisation […] of a former being´ (Baudrillard 1995: 79) which explains/ refers to the notion of `suppression of time´*. The antique, as a collectible exempted from purpose and function, carries a novel meaning such as particularity as a museum piece. Brown (2003) describes

> Collecting this appears as the most immediately obvious mode of keeping boredom at bay, of transforming abstract longing - the desire for something - into a desire for some (particular) things.´ [...] in the recognition that we use physical objects to arouse and organise our affection´. (Brown 2003: 163)

The former user´s (or better the owner´s) relationship to the object and the previous meaning of it, detached to the object at the time of production, distribution and use, shifts due to the course of time, into a different level of relationship. Baudrillard (1995) describes the status of an antique as follows:

> [...] that is not a par with other objects and manifests itself as total, as an authentic presence, it enjoys a special psychological standing. It is in this respect that the antique may be said, though it serves no obvious purpose, to serve a purpose

> nevertheless at a deeper level. (Baudrillard 1995: 79)

The author agrees with Baudrillard´s view on the antique and the shift from a practical usership to a symbolic ownership, although disputes the purposeless condition (related to practical use) of antiques. Preserving objects means transferring and shifting them through periods of times of usage (e.g. a munition artefact). Reflecting on the vast volume of objects produced, the amount of antique and collectible physically increases enabling owners to act as users. With the high volume of distributed objects comes choice and the opportunity to attach practical use to antiques rather than the preserving them and putting them behind glass. The author proclaims that signs of use, such as leather patina or other abrasive wear removing surface finish or material from a solid, add a meaningful, positive and desirable value to the antique firstly as an evidence of its origin, age, antiquity and authenticity and secondly as an information-rich source of human history. The author considers previous signs or marks of use a perceptual cue for present actors. An ancient walking stick might reveal the position of the owner´s particular handling enabling the new user to act upon the prior owner´s experiences with the object.

2.15 Speed bumps, proximity sensors and human agency

As discussed above, the appreciation, love for and collection of antiques preserves human occupation by its materiality and reveals the actor´s and consumer´s true experience with the object. We begin now to discuss Latour´s theory of non-human agency and the extension of the need of an universal actorship. This longer paragraph summarises, yet dismantles two frequently-used terms of the actor-artefact encounter. The author expands the latter of the two theoretical concepts on the *`hole-wall-dilemma´* relating the argumentation on human-machine encounter to politics, authority and social exclusion. The author concludes that technology can do people harm, in particular those who are vulnerable or less abled-bodied. Like speed bumps (Latour 1992) the actor is forced to react on the given surface around him. Especially the long handle of wheeled suitcases demands for an expert driving skills in order to manouevre the object over, around obstacle and other passengers. The long handle acts as an enlarged artificial extremity such as an arm or hand.

> A nonhuman (hinges) plus another nonhuman (groom) have solved the wall-hole dilemma. (Latour 1992: 157)

The groom, the door opener (*Türschließer*) thinks about the proximity of approaching users and reacts and thinks, based on how it has been programmed, either to start an action or remain still and rest. To discuss Latour´s conclusion that the hydraulic door closer does not bang the noses of those unaware of local conditions it means that although one is familiar with the setting, the building, the door, the groom, there is still a risk being hit and hurt by the single-hinged swinging door. There needs to be one key aspect clarified, which is how is the groom operated and how is the groom meant to be interacted with? Studying Latour´s describtions it seems to the author that Latour is writing about a manually operated door opener/closer by assuming pressing a button. Latour is not talking about a groom operated by a proximity sensor. The reasons why, the author´s assumes, Latour is referring to a button-operated mechanism activated by the users, lies in the following logic: If a human approaches the hole in the wall (door) a manual-operated door opener would not operate without intended interactions by an action from a user. In general any door closer (hydraulic or spring) stores the energy used in the opening of the door in a compression or torsion spring and releases it to close the door. In the case of an automatic non-motion sensor operated action the approaching user or passerby can get a bloody nose approaching the door when it is in a closing action. In a situation where a child or older user enters the building through that hole in the wall and rests in the given space, the door attempts to close without hesitation or interuption. This action is predetermined by the pre-force being released in the spring or hydraulic spreader. In case the child or older user, unable, due to cognitive or physical less-advanced body conditions, to jump back from the closing radius of the door (the

danger zone), would be exposed to hazard. A fit, healthy user can evaluate the situation in a split second and can react to the sudden movement of a closing door, slow or fast depending an adjustment of the pre-load force, and either not taking the risk to enter or escape from the danger zone. Despite the fact that technically the closing action can be manipulated, delayed and decelerated (a dashpot offers control over the closing force and speed), the situation remains the same. The door would open faster than it closes. In a situation where a user, with restricted sensory capabilities recognises, a child or adult lacking of concentration potentially due the distraction of a mobile phone, approaches the hole in wall in door-open modus, the slowly closing door would still be present, render an obstacle and can cause injuries. A proximity motion sensor controlled hydraulic door would react to all humans despite their pace or velocity, body size or physical or cognitive capabilities. Even an ill-placed wheeled suitcase would stop and block the door motion compared to an uncontrollable hydraulic door who would push any obstacle (and humans) within the aperture angle of the door away and out of the way. Nevertheless to describe the situation thoroughly and consider further more variables, one must include both users entering and leaving the building though the hole in the wall presumably at or around the same time. Disregarding the installed operational system, either manually pushed, button-pressed or proximity sensor-driven, the door can hit the opposite oncoming user, able-bodied and less abled-bodied. One can argue to use a glass door to recognise running traffic which may solve one problem with closed, inactive doors but it might multiply the problem on the other hand. A open overhanging piece of metal frame with glass is visually a difficult cognisable obstacle for passer-bies and door users willing to enter the building due to the fact a glass panel although allowing see-through when closed but positioned perpendicular to a building wall forms a dangerous spacial spot. As a conclusion one cannot rule out that hydraulic door openers cannot cause bleeding noses. The author concludes that hydraulic doors definitely can cause injuries especially to those users who are less able-bodied and therefore more vulnerable in foot traffic. The author argues that smart sensors can reduce the risk of injuries because they tend to detect the presence of nearby objects without physical contact ergo oncoming traffic better and yes in a more sophisticated manner, depending on data processing programming and algorithm, than simplistic mechanical systems which ignore running passerby and two-way foot traffic.

2.16 Objectifying artefacts, personal mark-making and localisation of objects

As discussed above, the relation of object authority and body conditions plays a major role in the context of object agency, the discussion now takes a turn to Gosden´s and Knappett´s definition on text on objects and (pre-linguistic) mark-making. This paragraph engages with the notion of mark-making as an attitude or behaviour of physical touch and materiality. Although the critical analysis doesn´t allow an intensive debate about script on object, yet in case human condition is evidenced by scars, scratches or other forms of inscripts or debris, a relationship to practice must be established.

Although the discussion about usage, meaning of objects and surface touch pays little regard to text on objects, the author discovers a relevance to the research subject on pre-linguistic markmaking or contemporary inscripts on object, for instance a carved initials in tree bark. The latter demarks not only the presence of a user but is linked with the assumption of a past emotional, empathic and felt experience or event.

The presence of mark-making in the context and localisation of objects and their setting, meaning and raison d'être, introduces Knappett (2008), partially supported by thoughts from Gosden (2004), as followed:

> But what I particularly want to look at here are the ways in which images and

> texts might alter the status of artefacts. Gosden talks of the process of display in museums as one means of singling out or objectifying artefacts (Gosden 2004).
>
> A similar kind of process is discussed by Mitchell, who observes the process whereby found objects (or more properly, things) are turned into artworks. [...] The ordinary thing is transfigured, yet its ordinary status is never quite forgotten; one could argue it continues to haunt the image. This could describe what happens in museum display too – an image is made of the thing through display and in the process becomes objectified. But the artefact's thingness never quite goes away. (Knappett 2008: 145)

Without a doubt, that, by the proactive engagement with the material of the exterior surface, a tree with a carved heart or initials, for instance, gains importance and creates an individual ownership. The engraver involved in the action might feel emotionally-connected to the object since the encounter and the contact through the sense of touch. The activist might return to the site caring about the tree well-being and investigating the location of the woodcuts respectively bark-cuts. Referring to the intense affection and love from children to soft toys, rendered through worn patches of fur, hair or fabric and even deliberately added cuts, scars and bruises might lower the market-value of the object but unintentionally builds up a huge archive of the owner´s personal mementos, souvenirs and reminiscence.

2.17 Technology and human innate needs, immaterial values

As underlined above one of the implications of Gosden´s theory of the status of artefacts is the shift from things to objects through display. Turning now with Dant´s and Classen´s works to the subject of technology, its impact and influence on human and social life. This paragraph concludes that the emerging *`technological deck´* (Winner 1986) is threatening to dominate the value of the immaterial spirit in human condition. However technology is perceived in general to serve innate needs for comfort and physical well-being. The threat that humankind´s relationship to nature and material is omnipresent and e.g. a labouring man´s life preprogrammed by machines.

> [...] the technological deck has been stacked in advance in favor of certain social interests [...]´ (Winner 1986: 26)

> […] technology has changed humankind´s relationship with nature and the relationship between individual and society. […] the critics suggest that technology has altered the human relationship with their material environment in ways that inhibit their full potential as human beings.
>
> […] the shape of history in modernity is `technologically determined´, that is, the form of society and the pattern of individual lives are detemined by objects that human beings have created.
>
> […] recurrent arguments around the theme that technology meets some human needs - for warmth, food, fuel, transport, entertainment, and so on - but at cost of something essentially human that no machine can substitute for - imagination, creativity, ideas, passion, love. The debate is about the materiality of human existence that technology supports and the immateriality of human existence, its anima or soul, that technology threatens. (Dant 2005: 34)

For Dant (2005) it becomes apparent that the concept of life as a modern individual is preassigned by technological tools that mankind has invented, introduced to and accepted by society. Dant admonishes (of) the threat that advanced technology, although the technological deck serves and supports human beings well enough in terms of comfort features, movement by means of transport, ubiquitous amusement et cetera, dominates and menaces the importance of the immaterial facts, the free spirit in human condition.

> For many in the early twentieth century modern life seemed above all to be about motion, the movement of machines and bodies, of merchandise and ideas, all at a whirlwind pace which collapsed previous notions of time and space. (Classen

2005: 401)

In agreement with Dant underlines Classen (2005: 401) the mindless shift from a slow-paced to a fast-paced life experiencing disengagement of the sense of time by the hegemony of technological bodies and machines.

> There is in the critiques of Mumford, Heidegger, Marcuse and Ellul a concern that a new form of materialism, introduced as technology with binds humans to objects in new ways, has changed the course of history. While the basic thrust of their arguments is for the reassertion of immaterial human values - those of the human spirit, of imagination, of spontaneity, of aesthetics and of emotion - they often overlook the way these are inseparable from the material lives of human beings and of society. (Dant 2005: 58)

According to Dant material values are intrinsically tied to immaterial values in human existence, although it remains unclear in which ways immaterial values serve human demands, requirements and desires. In the matter of fact it turns out to be apodictic that feeling warmth from the outside of the body cannot serve the same satisfactory notion of warmth from the inside of the body - which would proof the synergetic coexistence of both human values.

> […] electronic technology will increasingly disembodied and disengaged existence, as we become used to manipulating circuits rather than substances. There are those who long for the seemingly richer tactile experience of earlier eras, who perhaps spend their working hours at a computer but in their leisure time immense their hands in clay to shape pots or don armor and swords to re-enact medieval battles. (Classen 2005: 404)

The physical exercise of i.e. turning and browsing pages in a book, is an aspect of a tactile experience with a written document, a hands-on experience with words. Changing the physicality, the layer, the shape and the surface design of it (and its medium), the book page, e.g. by folding the paper creating a bookmark or tearing pages, could be described as a rich(er) tactile experience. Would you technically call an ebook subsequently an object (a book) or a thing? Gibson´s (1979) idea of an object is determined by perceptual cues meaning that an object with a certain format and thickness offers the appearance of a (closed) book. A thinner version of a book-format object offers a quick read. The distinctive shape of an open book though, all pages fixed to the axis of the binding, the imbalance between the amount of words already consumed and the pages still to be explored, offers a distinct appearance - that of a book. A thing lacks of or exists without the reference to a specific object or instance. A thing becomes, or grows into, an object by its realistic scale or proportion to the setting it sits in, by its history of use and by the user´s and producer`s or maker´s relationship to the thing.

2.18 Hand machines, computer fabric and unlocking by tongue

As highlighted by the works of Classen and Dant, one of the implications of technology is the increasing lack of embodiment and engagement with materiality. Following this line of thought leads to Featherstone´s theory describing disbelief against emerging computer technologies. This paragraph reflects on hand touch with technology, addiction to information technology relates disembodyment in work places to the desire to compensate virtual experiences with full body contact and engagement with soil.

The author considers, for instance, that the habit of holding a mobile phone in either hands, instead of putting it away and storing it in a bag or wear it on a belt, is a behaviour driven by either personal desire, pleasure or comfort of touch the object, which has a precious, cold and smooth almost pebble-like surface appearance. Or is it a behaviour to stay connected, wired and stay-in-touch at any time, ready to pull the trigger to connect

to the world immediately? According to Plant (2008: 2) the mobile phone was always an extension of the body´s anatomy: *`In Japan it is keitai denwa, a carried telephone, or simply keitai, or even just ke-tai. In China it is sho ji, or 'hand machine', […]´*. The author considers the emergence and popularity of the notion of smart materials, wearables and physical computing as potential attempts to respond and answer Classen´s and Stewarts´ concerns of missing tactile engagement with technology. Similar to the argumentation about refusing to acquire, sense and feel knowledge through the body senses with everday commodities and the built environment (Howes 2005: 29), rather escaping into full-body contact ball or extreme sports. To refer once and again to the research practise the author can draw from observations during early prototyping stage, highlight the experience of those you are afraid of technology or inhert the omnipresent opinion to fear for instance artificial intelligence in particular represented by robots. Early touch-sensitive prototypes were connected with a cable to a computer to read the data measurements. Although the improvised prototypes displayed an accidental and unprofessional image, it was surprising to recognise that actors were amazed and approached the test objects with reluctance due to inherent apprehensibility to the stimuli of threadbare and specious high-tech. A good argument disseminates Featherstone (1999: 11) by underlining the human adherence in society of disbelief and mistrust against digital technology, instead of accepting it.

> The latter two revolutions [transmission and transplant revolution] have interesting potential effects for modifying the body. They direct us to the ways in which human beings are having to learn new ways of inhabiting technology, in which the world is approached through the mediation of technological environments, on the one hand, and the ways we will have to cope with technology inhabiting us, on the other. Nanotechnology and miniaturization will involve major forms of body modification. (Featherstone 1999: 11)

Having written about touch and the carried phone, body modifications and technology James Auger´s speculative product *Audio tooth implant* (2001) offers a provocative and debatable concept of a hands-free conversational experience with the world through modified miniaturised mobile telephone embedded in one of your teeth. The introduction of the product concept turned up as a shock and was received a the downfall of the Western society caused by the invasion of Nanotechnology and miniaturization. Referring to hand knowledge and the kinship to mobile devices, expressed and perceived by constant contact to the human skin, it might be possible now to unlock your communication device by a swoosh of the tongue instead of the finger.

Conclusion

In opposition to the previous chapter underlining the user or actor in the role of a lobbyist, this chapter focusses on the authority, meaning and use of objects. Here the line of thought starts from the object which directs affordances to the actor. In the previous chapter the initial point of the discussion is viewed through the perspective of the user directed to the object world. This chapter deals with the intention and thoughts derived from objects, ignoring the demands from actors summarised in chapter 1. Initially it is significant to approach the key question `What is an object?´ drawing from the knowledge of different main scholars, schools and disciplines, including Brown´s position of a thing remains un-nameable (2003), Schwenger´s statement that thingness of a thing is untouchable (2001) and Gosden´s call that things are defined by appearance, location and setting (2004) rather than words. Gell (in Gosden 2005) also suggests the idea to discuss the impact of the material world on to how it affects human relations. A practitioner forming clay from primitive nature and substance into a resilient, ductile, non-reversible and durable solid, demands knowledge, mechanical hand skills, tactile and sensuous understanding of the homogeneous material. Materiality becomes the main argument for receiving (and responding to) perceptual cues and the effect cannot be separated from the object. The material(istic) attributes remain attached the original bistro chair and cannot be translated by other materials. Nevertheless the author agrees that the attempt to replace the material,

following the regime of maintaining the form and shape of the object, can be an effective notion to crosslink or reevaluate established meanings to popular objects.

Chapter 3

Surfaces

Introduction

Chapter 3 deals with surface touch of tangible objects. It discusses the sense of touch in comparison and in addition to other body senses. It informs the research practice which attempts to investigate tactile experiences in the sense of documenting and capturing human behaviour.

Surface touch is discussed here from different angles, such as scale of surface related to human or non-human body (Gibson 1986, Latour 1999, Lorimer 2006), bodily sensorimotor experiences (Lakoff 1987), artificial body extension (Featherstone 2007), technology and touch (Plant 2008, Classen 2005), active bodily engagement with the *Umwelt* (Uexküll 1957, 1992) and design and surface modelling from early and late pioneers (Corbusier 1959, Teague 1955, Rams 2009, Ive 2013). Alongside with surface contact derives the question of the relevance of traces, marks, imprints, inscriptions or messages as discussed with scholars such as Mouto (2007), Brandes (2009) and the materiality, gravity and *`matter-flow´* (Ingold 2007, 2010) and making of things (Kondo 1990). The engagement from occupants with object surfaces in housing culture, artefact-actor interactions and concepts of ownership are introduced and discussed (Miller 2010, Dant 1999, Buchli 2010) later in the chapter. Exemplars of embodiment and mapping information support the notion to preserve human occupation via materiality and topographic projections (Snyder 1987, 1993). Included in the discussion is what makes a surface compound differ from an object, which was also discussed in chapter 2.

3.1 What is special to a surface?

> In geometry, a surface is described as: `A continuous set of points that has length and breadth but no thickness.´ (Oxford Dictionary)

In topology, or often referred to as *“the mathematics of continuity”*, a surface, a two-dimensional, topological manifold, is a separated space which locally conform with a real n-dimensional space (Kelley 1955, Simmons 1983). The arrangement or concept of surfaces, connected, closed (compact) or open (non-closed), represent the exterior and interior of physical objects. In mathematics the following keywords occur describing a concept of surfaces: orientation, contact, neighbourhood, volume, form, entity and vanishing, which builds a useful set of words for further discussion on surface touch. It is no surprise that artistic drawings, and that is what design drawings basically are, and in particular technical drawings in industrial design and those derived from the touch-sensitive calculations from the author´s practice, have a strong affinity to descriptive topology. Descriptive topology, according to Francis (1987: 16) is a method to *`[...] unfold the visual secrets so often compressed into algebraic shorthand`* and a *`[...] theory concerning the generic forms of a surface extended in space or mapped into a plane´*. The power of spatial imaging is described by Francis as: *`[...] expressing geometrical information in that universal language of mathematics, algebra, has been immensely useful in the service of precision and economy of thought´* (1987: 16). In the area of architecture, modelling buildings and designing living spaces and surfaces, Leyton (2006) describes the foundation for geometry as follows: *`[...] extensive analysis of painting, music, and design, my mathematical work has shown the following: Aesthetics is the theory of memory storage´* (Leyton 2006: 89). And continues to render the implication of computation for art referring to the idea of converting the ideas, thoughts and the environment into memory

stores: *`[...] words, both the sciences and the arts are driven to create maximal memory, and aesthetics is the means of accessing that memory´* (Leyton 2006: 89).

Surfaces of all sizes, scales and shapes provide a kind of white canvas awaiting actors to read, use, write on and put marks to them. Man-made surfaces, as they occur in the shape of computer screens, door handles, slides on playgrounds, basketball pitches, hiking trails, roads, grain fields and vegetable patches and so on. Natural ones, such as among others hillsides, mountain peaks, glaciers, rivers, rocks and pebbles on the beach, sand. Surfaces are vertically or horizontally linearly aligned, multi-axial or underlying constant change of spatial orientation (inter)facing the actor and pull of gravity. Surfaces in form of a solid or block are possessed by actors or the other way round the actors can be owned by the presence of surfaces: a small, shiny and glossy surfaces appearing as part of a piece of jewellery, or large black wall as part of an exhibition space in a gallery, for instance. Lorimer (2006) discussed surface and biodiversity and added the term detectability to non-human affordances.

> The detectability of a species can be understood as one dimension of a broader property that I have elsewhere termed 'nonhuman charisma' (Lorimer forthcoming). Nonhuman charisma can be understood as the distinguishing properties of a species, process or ecological complex that condition its relative awareness to human perception and subsequent evaluation. The detectability of a species relates to the ecological dimensions to this non-human charisma and describes how easy a species is for a surveyor to encounter, identify, differentiate and record. (Lorimer 2006: 549)

Lorimer (2006) explains and concludes finally:

> […] approach draws attention to the important affect of the body—both human and non-human—on both enabling and constraining the construction and subsequent implementation of framing assemblages. (Lorimer 2006: 549)

3.2 Surface wear concealed messages and sign of wear

This paragraph introduces the reader into the subject of surface material and wear and tear on objects. It is discussed here how technology can assist the display of concealed, hidden inscripts and imprints. In the chapter the author focusses on visible signs of wear and tear on objects caused consciously or intentionally and non-intentionally (Brandes 2009) by bodily engagement, via touch, and the evidence of use hidden, concealed marks, imprints, inscriptions or messages (Mouto 2007) in form of traces and surface wear. The chapter is highly relevant in terms of the author´s research practice on developing a touch-sensitive matrix applicable to objects of nearly all kinds, forms and functions. In addition to the term hidden message, engraved and materialised in objects by surface friction i.e. sign of wear, detrition, attrition of surface material, the expression hidden needs further exploration. A hidden message can either mean firstly a message most people are unable to receive, perceive or read. Either due to the general inattentive or ignorant opinion on and relation to objects, to the lack of sensitivity or sharpness to a failure to recognise signs of wear on objects and the intrinsic latent narrative in them. And secondly hidden due to the fact that the signs of use are minimal, vague, and invisible to the naked eye i.e. even if someone were looking for it. To find, locate, reveal and read the signs of use, either a well-trained expert eye, such as dog´s sensory system, is needed, or by applying, yet inventing and developing specific methods of assistive technological aids, to capture human occupation.

3.3 A blind man´s world and body of touch

In this paragraph the blind man´s world and the body of touch are explained to understand the concept of hand and skin knowledge, their language and currency. Despite the benefits of a multisensoric engagement with the physical world, however there might be a risk of

contamination as introduced by Casio (2004).

In this context Uexküll´s (1957, 1992) argument on the perception and perceived world of blind people he is incorrect in stating that *`The blind man´s world is a very limited one: it extends only as far as he can feel his way with his feet and cane´ (*Uexküll 1992: 363). Referring to David Howes´ (2005) view on body knowledge there is little doubt that a blind man´s world is far from limited and as rich as any able-bodied and fit man´s world. The significance of surface touch, touch through body muscles, ligaments, skin and body hair, and touch through fabric as a man-made layer between the body and the environment, and counting hand knowledge, skin knowledge, ear knowledge as full body senses of our sensory network addressing a change in temperature, hum, sound or breeze provides a rich sensory input to understand and interact with the *Umwelt*.

As computer technology impacts more and more our tactile engagement with the physical world, it is exactly how Classen (2005) describes and forecasts, that the proportionality between a tactile move and damage control seems to be off-balanced and impacts remain far from measurable.

> The remarkable effects that can be achieved with minimal effort are a distinctive feature of modern technology found in many consumer products. The flick of a switch, the push of a button can turn on heat and light, can start cars, can make worlds appear on televisions and computers. Thanks to modern technology, even a twitchy finger can have explosive effects. (Classen 2005: 404)

Casio (2004) provides a good argument and foremost if body touch should be postulated in comparison to non-tactile experiences, the potential disease transmission can be an issue. Tactile contact at a current airport support transfer of germs and viruses in the globalised world, and it is beyond imagination how an airport designed for body touch to experience would cause an outbreak.

> Computer-enabled fabric would serve as a remarkable interface between ourselves and the environment. Embedded with sensors, clothing could easily alert us to airborne contaminants such as pollen, particulate pollution, carbon monoxide, or worse. Similarly, it could keep track of our health, responding to bodily changes reflecting illness. (Cascio 2004)

Traces of use on the surface reveal the objects history, sometimes in broad terms, sometimes with precise, meaningful and clear messages. In case traces are visible, or made visible by, comes with the fact that they are presented to actors and investigators who can draw conclusions from the them. Hidden traces can be made visible by e.g. a contrast powder to reveal grease residues left by a finger or a hand or by e.g. a clay casting from shoe sole, to be used as evidence for human presence. It could be argued that through the display of traces of use, actors are led, guided, influenced by previous actors by the way those occupants have inhabited, interacted, used and engaged with the objects or environment. It could be further argued that those marks, imprints, residues and deposits developed, presumably non-intentionally (Brandes 2009), by change, modification of and friction with the material surface, can be defined as marks, engravings or symbols, such as *`a carved heart cut into the skin of a Sycamore tree´* (George R in Tilley, 2006). In order to recognise and translate marks on objects as symbols or words, the reader of the trace needs to first(ly) and foremost notice their existence, either with the naked eye, through a camera lens, with a skilled, knowledgeable eye or by applying investigative techniques or by the support from assistive technology, such as an artificial body extension such as for instance prescription, night-vision glasses (McLuhan 1964; Selim, Aguilera-Hellweg 2004). Secondly, if symbols and words are perceived, the current reader must be able to speak or at least understand the vocabulary of the same or similar language, to reveal the meaning, the narrative in them, implemented by previous owners or occupants. Thirdly relating to the fact that the reader might be indeed `knowing´, it could be argued that he or she could use the techniques of writing and reading in a certain language on material surfaces to deliver messages, hidden from those, who don´t have access to the tools described previously, and influence the way, how potential actors will engage and interact

with the object or environment. Considering the fact that, depending on materiality and material properties, the abstraction of words and symbols, either latent or visible (public) can be easily removed either by an intensive rinse, by replacing the outer shell of the object or environment, or the entire object itself (Miller 2010).

> When there is a change of au pair, the slate is wiped clean and one can begin again with the blank white surface, the impression of the previous occupant removed more or less instantly. (Miller 2010: 90)

In contrast to the ease of erasure, which comes with the change of furniture described above, stands the concept and the impact of scraping, scratching or carving into a surface material on long-lasting (durable) fittings. Removing substance from a solid instead, e.g. an in-built room fitting, exposing sub-surface material in order to answer the question "What lies under the object´s skin?" can be described as a person´s own liability to (firstly) engage bodily with the object and secondly to make a long-lasting and irrepealable commitment to materiality. The action of mark-making can be interpreted (thirdly) as the urge to preserve a moment (derived from love or hate), an event (happiness or boredom) or an occasion, or the relationship to a specific person, location, setting or (date &) time. Surface extraction is, due to the fact that a part of the material is permanently removed, a severe mechanical invasion into the object´s skin. The beauty and magical effect of engravings lay in the fact that they create a (semi-) public statement or a potentially highly-visible landmark for, new-occupants, newcomers or descendants. Most interestingly, most scholars (Miller, Dant, Ingold) refuse to consider the notion of material sampling as a form of documenting and interpreting the bodily engagement with the world. Herewith not only the image derived from the carving is a manifestation of human occupation but also the material, the sample, removed from the surface most of the time left unappreciated on the floor or remain in the carving tool. From a trace analyst´s perspective the material sample, removed from a wall or floor of a (crime) scene is the most important evidence to reconstruct a past scenario.

3.4 Material scars, pre-linguistic marks in the bark of a Sycamore tree

The author links meanings of scar-making and pre-linguistic mark-making and carving to the meaning of ownership and temporary possession. The subject of time becomes relevant e.g. engraving in beach sand in terms of temporality or ephemerality or carving a heart into the bark of a tree which is a document subject to perpetual modification and manipulation by a natural growing material (to treat, dress or seal a tree wound). Scar-making opens a new chapter of a discussion on the engagement with the surfaces of the personal body which should remain secondary for this critical writing on the surface touch of objects.

The author´s engagement with the topic, the discussion and argumentation are focussed on abstract and concrete images adherent to objects, surface history, their representations and time-related manifestations of cultural heritage. The review deals with surface properties, touch, artefact-actor interactions and concepts of ownership (Dant 1999), relationship and kinship (Buchli 2010). The review excludes images or symbols based on text and written inscriptions, however in the case letters or words are inscribed by a tool, cut into or manifested by removing material from interior or exterior material, it can be relevant and part of the discussion. Significant images and means of story-telling can be produced from and created through physical modifications i.e. by adding or removing material from solids, abrading man-made particles such as paint, varnish, surface finishing, coating and related effects such as corrosion, rust and material decay, or abrasion by natural particles such as leaves, snow, dust, sand and so on. For instance, traces such as imprints on the beach or in a soft grounds of a hill walk left non-intentionally, an engraved symbol or text written (a love heart) with intention in the sand or on the fossilised teeth of mammals (McPhee 1981) are considered as significant and relevant forms of human (or non-human) traces because firstly the process of making them involves a set of deliberate

human actions, and secondly the duration and existence of those signs depend on time, enabling or facilitating a reconstruction of past events and the scene historic properties. The duration of the traces depends on external factors over time and they afford the ability for history to be reconstructed. Street art i.e. a tag sprayed onto a wall or a character produced by a stencil, is not in the author´s focus.

3.5 Surfaces communication and authorised affordances

This paragraph discusses the design of surfaces, their transition and compositions into solids and later objects with meaning and function, as opposed to their consumption. The terms semantics and aesthetics are described as is the authorities of localisation. It is further described how the skin of the earth might be experienced by the sense of touch. Key aspects relating to the existence of solids, surfaces and objects are discussed. Such matters as materiality (Dant, 2005; Miller, 2005), production and mass ware, consumption (Featherstone 2007, Miller 1987, Gay, Evans, Redmann 2000), affection and ownership, user audiences (Hunt 2013, Cooper 2004), real setting and everyday commodities (research practice).

The functionality, *Funktionalismus* (Corbusier 1959), the meaning (Csikszentmihalyin 1981, Pinney, Thomas 2001) in terms of symbols, tools or visual images and appearance in spaces, settings and events are relevant aspects to the actor´s relationship to objects. The use and handling of an object are widely, depending on locality, spatiality i.e. arrangement and orientation in space and context, more or less holistically described. The user can be a human animal (Latour 1999) - a child on a swing, a wheelchair user entering a building - or a non-human animal – for example a cat running up a tree, or a sheep or goat balancing on a hillside. Despite the material surface, outer shell, coating, surface treatment, surface finish and its physical body, the way faces of an object are being held together in place, connected to each other and the specific type of transition angle from one surface to another, have an impact on how traces are produced and developed. A sharp edge alongside a table, for instance, can cause, in comparison to a filleted, rounded one, a different set of human traces of use. The intersection of surfaces, and surface angles with which compositions are built, influence the way the actor interacts with the physical object and ergo the way frequent touch changes the appearance of the relevant material. If we believe that the perception of objects is created through usage taught from childhood, it remains unclear how we interact with newly developed objects, or how novices act upon established objects and unprecedented and culturally inaccessible objects. The question is subsequently, possibly to be answered by psychologists, at which stage of our development do we stop being educated by the objects that surround us?

> [...] containers are important because they afford the enactive realization of the container `image-schema´. That is, of an image-schema that consists of (1) a boundary that demarcates (2) an interior from (3) an exterior. (Knappett 2010: 3)

The exterior, skin, shell or face of a container such as a pot or vessel, withholds an image or image-schema (Lakoff, Johnson 1987) which communicates to the actor or reader of object meaning, what to do with it. An image i.e. image-schema is defined not just by perceiving by sight i.e. by visual perception, but also by tactile experiences. Lakoff (1987: 386) defines: *`[...] the very structures on which reason is based emerge from our bodily sensorimotor experiences´*. If tactile experiences, surface touch and bodily capability are in demand exploring a surface, form or object, it can be argued that, with a vessel or pot, it is not just the exterior that counts, but to the same extend, the interior. As actors explore or read surface by eye, they do by touch in order to explore unknown territories, to get answers to enquiries, such as „Is the skin soft or hard, cold or warm, ductile or brittle; is it real or synthetic fur, has the object been used over time or is the surface trimmed old and so on“ and to gain a better understanding about materiality. It can be argued that surface touch is a method to confirm their preconceptions introduced by visual perceptions of established surface pattern or structures. For instance, the actor is asked to act with two fingers, like a pair of pliers, if forced to carry two cups from A to B, if just one hand is available. Nevertheless, it is fair to say, that an able-bodied actor,

accessible to a full set of sensory perception system, would use tactile engagement to seek proof that a cone-shaped object with an open cut as opening on top, is actually an object or surface composition to hold fluid in place. On the other hand, a less able-bodied actor, confronted with the same situation, would have to use his or her sensory- motoric awareness to engage with the solid, exploring the interior and the exterior, switching boundaries between the outer and the inner surface skin, to understand the function or practical use to the thing, with the attached meaning being a pot or vessel. It could be argued that able-bodied actors, in particular adults, hesitate to engage with surfaces by touch to gather information about the meaning of matter (related to surface experiences). Material properties, described by adverbs such as soft, responsive, matte, shiny, glossy, and transparent and so on, are factors for manipulating the usage, handling and operation with physical matter or solid objects. The weight of objects play a role, and so the amount, to which extend tracage (use=usage; trace=tracage), friction, wear and tear are developed. Despite material compositions, appearances, properties and finishes, it is the designer`s decision on how to let surfaces of solids intersect and hit each other, which communicates the intended handling and sends a highly relevant message to the actor on which terms to operate with the object. A sharp edge, for instance to refer to Gibsons´ term of affordances i.e. semantic obligations as a rule of form language, proposes or offers to misuse the object for e.g. cutting things. A public statement (on YouTube) was made shortly after the new Apple Airbook was released on the market with the idea to add an additional function to the laptop. Some costumer thought that the extremely sharp front edge of the laptop affords to cut a roll into two halves.) How it is possible to relate affordances to a single or assemblage of surfaces rather than to a functional object implying a vague or specific message how to use it? In comparison to Jonathan Ive, Richard A. Teague, a key figure in the design of industrial objects, was an earlier pioneer in modelling sets of surfaces of objects, applying contrasting materials and balancing diverse material properties, textures and semantics with elements such as the one-piece curved windshield and character belt lines in automotive design in the 1950s (Popular Mechanics, February 1955).

> Both Browne and I were drawing cars when we should have been drawing aircraft, [...]. (Richard A. Teague, year unknown)

Especially Teague´s addiction and commitment to sharp edges and kinks as decorative elements of style and appearance, tear-off edges borrowed from aviation and the principles of air flow around an aircraft to be of secondary importance for the success of the vehicle, had an impact on the relationship between surface form and function. The author assumes that a smoothly sculptured freeform-surface can be interpreted, by some users not by all of them, as an invitation for touch, ergo affords close haptic and physical contact with humans in relation to exterior spaces and interior fittings, such as a chair. In terms of addressing senses this can occur, either with a gentle stroke with the fingertips or with the desire to lay down, rest and relax. In comparison to smoothness comes sharpness and it might be that smooth forms suggest defensiveness or calmness in terms of the desire and will(ingness) to be touched. If so, does it mean that smooth surfaces tend to produce more user wear than edged surfaces because edged surfaces are less attractive?

Concluding from the observations during the author´s research practice, the proband actor´s touch behaviour, using finger and hand movements on a rough, bodyhair-like texture, e.g. goat suede, were, despite the form, controlled by pausing and slow movement. It could be argued and the author presumes, without applying in-depth psychological knowledge, that the slow-motion can be explained by the desire of exploring the area of touch seeking for something buried in the micro valley of the goat´s skin. In comparison to a rough surface finish which invites actors to rest, stands surface evenness and the paired notion of velocity, feeling the urge to move on in order to gather information by the sense of touch. To complete the thought on surface gesture and the effect on actors, it might be necessary to add elements such as colour, coating, finishing and texture to surfaces. Further into account one put felt experiences such as how do users perceive the surface properties in terms of temperature, resonance, weight, acoustical and physical feedback.

Previously in this chapter the author has discussed the intuitive behaviour of children to

interact with the world through full body contact. Adults in the western society seemed to have lost the ability to generate knowledge through physical touch. Anthony Synnott (2005) describes in the chapter the physical relationship between mothers and their child's historically and led by contrasting parenting and educational techniques. An interesting element is embedded in the thought, how do children transfer the parental warmth or coldness onto soft toys. How traces of extreme affection and endless love would cause traces of wear on soft toys. It is clearly documented? That an investigator or any other non-expert can tell the difference between a much-loved teddy and a teddy which, disliked and disregarded, has been sitting on a shelve of a cupboard the hole life.

Howes (2005) discusses the earth´s skin, scars and bruises of untouched nature and man-made landscapes *`dried by the sun and roughened by the wind´* (Howes 2005: 33). The fact that putting traces of use in a contextual relation to scars, injuries and domestic surgery with soft toys, leads to the keyword of repair, amputation and dressing (material) attached to the body. Can the interpretation of this notion, or form of re-shaping the exterior and interior surface by the child create a history of the surface condition and object interaction? As it is in the author´s interest to establish novel methods to 1) freeze human contact, touch and interaction and 2) capture, record and document various traces of use on objects Howes (2005) provides a vital explanation about the anatomy of a landscape. Although Howes directs his arguments from a different angle of context to the subject, than the author, who is interested in physical change of surface through use, handling and operation by human and non-humans, Howes provides a vital thread when he writes:

> [...] the earth is evidently conceptualized as dead. All that is left is to dissect and classify it, and to transfer the knowledge of its skin onto portable skins of maps. (Howes 2005: 32)

3.6 Mark-making and skin-mapping

In this chapter it is discussed how surface wear can be displayed to make informed decision upon the use of specific objects. A technique is suggested, similar to cartographic or thematic mapping, whereas the exterior of object bodies is unfolded in order to localises areas of surface alteration caused by human touch. The fact that mass products are similar, or even identical in dimensions, before they are purchased, distributed and used, the differences in use can be compared based on areas of material worn, damaged or faded.

Relating the cartographical concept of map projections (Snyder 1987, 1993; Ehrenberg 2005) of the earth´s skin to the previously discussed concept of the exterior of soft toys, the author underlines the significance of, however speculative, visionary though, map-making techniques on pre-used soft toys in order to understand human condition. Determining, displaying and classifying the tracage of e.g. teddy bear to tell where it has been hugged, cuddled and stroked most, the execution of removing the skin of a teddy carcass is a method, similar to drawing a map from a territory - a geographic region with borders, to apply.

A map contains both natural and man-made elements such as rivers, elevations, demarcations and so on, but also state borders, bridges and fuel stations and so on. Nevertheless a teddy bear as a designed and fabricated mass-ware (Woodward 2007 on `The Bible´) underlines certain rules of limitations in material and process which interfere with the information embedded in the exterior skin if unwrapped and unfolded from a three-dimensional solid into a two-dimensional surface. For instance, a stitching line or a cut in pattern is defined and indicated on the unfolded map of the teddy´s skin, however representing nothing about the use of the object. A hand stitched curve appears has a different image as one which is created by machine sewing. Due to the fact that soft toys are mass-produced, distributed a large numbers, last, circulate and remain connected with its owner for a long period of time, tracage of use is numerous, versatile and rich, but the interpretation diffuse and vague. The approach to unwrap a soft toys skin to display

the topography of frequent use or other points of tactile interaction, is an interesting route to follow to create images of human affection to objects. In particular in order to juxtapose differences or similarities of tracage, a number of skin maps from the same batch or product series can be compared and areas of touch categorised. In order to hypothesise the concept of skin-cartography the visual images produced from different sources, consumers represent a rich archive of human contact. In the previous context of the material culture and soft toys, the virginity and pureness of manufactured, brand-new and untouched surface skin represents the slate i.e. white board. This surface offers the ritual to be written on, through intensive touch and body contact with its owners, motivated by their relationship to the soft toy expressed through the immense love, physical affection and proximate affinity.

3.7 Body hair, grass patches and ad-hoc actions

It is argued here that body hair knowledge is compared to skin or body knowledge a less obtrusive method to get in contact with the physical world. An exemplar of the life of the Incas supports the concept and it underlines the inherent necessity of human and non-human animals, whereas arms-length relationship to material is disregarded by the first group.

In the chapter `The Skin of the Earth´ Howes (2005) writes about the mythology of the Incas, describes the life of the Andeans and compares the relationship to it as body and skin. In Andean cosmology earth is defined as mother earth with rivers as veins and grass for hair. Body hair, as a sensitive, thin and complex human organ operated to interact with the physical world, perceive tactile data and communicate with others, has its own form of perception and expression, its own vocabulary and language, comparatively to the grass and flowery meadows as body hair of the earth, referring to Howes (2005). Grass represents, based on Howes´ argumentation, a layer between the earth and its occupants or inhabitants and acts as a form to stay in contact with the earth, and according to Classen is linked to the subject of time (Howes 2005: 30) *`to touch the earth‘s skin is therefore to live in the present´*. The author understands no difference between expressing love to the active earth, by laying on grass or letting grass slipping through the fingers, like people do with hair and brush, and expressing love to a to a dog, cat or any other pet by touching its skin. As nearly the entire body surface of a dog is covered by fur, the dog understands the language of touch as way to perceive human contact. It needs to be further argued if the hypothesis if body hair of human or non-humans can generate knowledge. We know from past experiences and knowledge we gained through an understanding of the world of blind or partially sighted people that humans use body hair to interact and understand as well the close and as the far distanced environment. The slight body hair contact, for instance safely hiding in a thick bush or subtly testing the distance to other passengers in a crowded bus, provides actors with a sense for spatial awareness and in the cases described sense of security. Body hair can be a viable method to communicate with others without informing others about the intention. The question occurs here what would happen when object hair meets body hair? The answer lies (somewhere) in the proximity of surface materiality, measuring and controlling the nearness between the bodies and the objects. Human body hair acts or functions as distance-measuring, but remains, compared to a non-human animal´s tentacle or e.g. a snail´s antenna, less distinctive and underdeveloped as a sensing device. A soft, fur-like surface on an object or body demands greater activeness, greater spatial approximation, physical closeness and touch in order to explore and understand the shape of the body. The author sees a direct link to the observations from Ingold (2010):

> As practitioners, the builder, the gardener, the cook, the alchemist and the painter are not so much imposing form on matter as bringing together diverse materials and combining or redirecting their flow in the anticipation of what might emerge. (Ingold 2010: 94)

Physical touch is an ad-hoc action and is therefore a subject of time. Acoustic, visual and

olfactory senses are patient, but tactile experiences take immediate feedbacks. Full body touch, for instance tells a person in the next seat, a fellow traveller or the person next to, directly about your presence. Body hair contact is less obtrusive and freed from reactivity. According to Howes (2005) and his argumentation that the existence of skin, hand, body and ear knowledge is relevant for interacting with the earth, the author argues that body hair knowledge is, as a sub-division of body knowledge, responsible for perceiving and communicating with humans and non-humans, the world and the environment. Body hair knowledge is, as described above, a subtle, nonreactive and unobtrusive method to get in touch with the physical world.

To address and answer the question if used surface of furniture can act as story-tellers about individual use by the occupant, Miller (2010) provides a scenario about accommodation of au pairs, the choice of design, style and material. Miller writes about au pairs in London and their host´s decision-making process to furnish the guestroom, the au pair´s temporary accommodation.

> Just like the au pair herself, white melamine from IKEA is generally seen as inexpensive, generically European on a young, modern poise, characterized by cleanliness, functionality and efficiency. Hopefully reasonably long-lasting, and quite easy to replace. When there is a change of au pair, the slate is wiped clean and one can begin again with the blank white surface, the impression of the previous occupant removed more or less instantly. (Miller 2010: 90)

Miller (2010) describes the surface of the room fittings and pieces of furniture as a skin of touch, a blank canvas ready from the inhabitant to be painted on during their short-term occupancy.

3.8 Matter-flow, gravity and redirections of dynamics

In this paragraph the author proposes a derived thoughts related to prescription landscape possess and how spacial dynamics influence human condition. According to Ingold (2007: 314) and referring to the established rule of thumb to follow the materials, or as Deleuze and Guattari put it *`this matter-flow can only be followed´* (2004: 451), a wavy natural landscape, formed by erosion and geologic formation, leads the walker to react to its dynamics by running or jumping or rather the opposite resting or lean-to shelter depending on the scale of the surface design. Similar to natural hills an artificial skateboard park invites actors to accelerate speed against ground, work against the force of gravity and to fly high in the air. In automotive design these semantic rules of dynamics and matter-flow, based in themes of acceleration, agility and accumulated energy (or by just even looking at a winding road), are revealed through the form of exterior and interior to symbolise the vision of speed.

> More generally, whenever we encounter matter, as Deleuze and Guattari insist, ‘it is matter in movement, in flux, in variation’. [...] What Deleuze and Guattari call ‘matter-flow’, I would call material. (Ingold 2010: 94)

> Accordingly, I recast the assertion as a simple rule of thumb: to follow the materials (Ingold 2007: 314).

Ingold (2010: 94) further introduces the notion that different professions deal with the inter-modality of materiality and the affordances for actors, human and non-human animals. The gardener by cutting bushes, felling trees or shortening grass modifies the flow of the landscape intentionally or non-intentionally. A fresh mowed lawn might invite non-human animals such as pigeons to settle picking insects or sprouts and consequently might influence the behaviour of human animals, such as children playing tag or running around.

3.9 Shokunin, the artisan, meken una and the Cashinahua

In this chapter the author speculates how an environment can be shaped, developed and grow, and look, smell and feel like, derived from the thoughts of the Cashinahua that skin knowledge comes over brain knowledge. Plant (2008: 2) describes a number of terms for a carried phone: *`keitai denwa´* in Japan, in Germany it is the *`handy´* and in China *`sho ji´*, the hand machine. As Dorinne Kondo (Crafting Selves 1990) narrates the kinship and relationship, more specifically the mechanization, between „man" and „machine" in Japan exempt, freed or detached from the domination of the interdependency (and alienation of the human animal by it) and writes: *`the term shokunin [artisan] was used for virtually anyone who worked with his hands, even for people who seemed to be doing assembly-line work´* (Kondo 1990: 234). The author proclaims that it would be, according to Kondo (1990) and Plant (2008), too simple to call anyone, a worker, builder, trader and so on, carrying a mobile phone in hands, an artisan who might be remotely controlled, dominated and alienated by digital technology and circuit boards, in terms of the execution the professional work, its doings, habits and behaviours. David Howes (2005: 28) introduces in his chapter `Skinscapes: Embodiment, Culture, and Environment´, a narrative of the Cashinahua of Eastern Peru and their various techniques of bodily knowing. The Cashinahua, who are in their history and culture are denying the fact that the brain had any role to play in cognition along with skin knowledge, hand knowledge (*meken una*), eye knowledge (*beda una*), ear knowledge (*pabinka una*) and other bodily intelligences.

The author considers the act of affordance perceived through bodily organs interlinked or interwoven with the ability of skills in gaining hand knowledge by practise. It can solely be achieved by long hours of exercise, persistent use or long years' experience in, for instance playing tennis or writing text messages for several hours a day and night. The thumb generation, or *`textperts´*, is a group of members of a mostly young generation, applying intensive, consistent and extremely fast coordinated technique to use of virtual keyboards, texting and responding to incoming messages, expressing therefore their acceptance of and addiction to information technology.

> For one thing, the urban environment is generally designed so as not to impinge on our skins. We do not push through brush on our way to school or work. Roads and sidewalks are kept clear of obstacles. (Howes 2005: 28)

The question occurs about how a world might look, feel, smell and sound like, according to the knowledge-seeking, or information-seeking experience of the Cashinahua? Referring back to how people walk, commute and travel through the built environment, designed spaces and interact with man-made objects in the Western World, there is little evidence of, and it seems little urgency as well for, tactile stimuli. Howes (2005: 28) refers to the „outside" as a space of transition (transitional spaces):

> „Outside" is often just a space we go through to get „ inside." Our time is largely spent indoors, where architecture and design collude to provide an environment as devoid as possible of tactile stimulation. (Howes 2005: 28)

3.10 Surfaces, affordances and body (skin) knowledge

In this paragraph the notion of children embodied sense of materiality is highlighted accepting contamination by dirt and soil. It is described here how children act on spacial, bodical and symbolical stimuli disregarding physical boundaries and barriers. The subject of time is relevant for their actions as they act ad-hoc, without hesitation and without thinking about consequences.

Children, for instance, do not inherit, possess or show a fear of full-body touch (Classen 2005: 404) and tend to explore natural landscape, as skinscapes, and built environment, as their playground, with their entire body to the full extent, until physical and cognitive fatigue to total exhaustion. Referring to Gibson (1999) children do afford designated and predetermined obstacle and referring to Howes (2005) bodily intelligence as means,

vehicle and avenue to play, sit, stand, lay, jump, taste, smell and lick.

> […] If the skin is indeed knowing, standard Western interior design does not often give it much to think about. Perhaps the tactually unengaging nature of much of the modern material world is a product of your arms-length relationship to the environment. In the modern Western city only children (and gardeners) usually have much full bodily contact with the ground. Adults typically perceive the ground as dirty or even contaminating, and therefore limit their contact with it. (Howes 2005: 29)

In order to explore the physical world and built environment, adults do not tend to aim for that kind of skin experience and tactility with the outdoors. Adults in the western world rather aim for virtual experiences. Children or gardeners (Howes 2005) or other shokunin (Plant 2008) do engage with hand and soil, ground and obstacles even if they, based on ignoring their human body size, ill-fitted, uncomfortable and alien(ated). Even they, the earth, the object, the obstacle, are not designed for a specific use, purpose or reason, are targeted at them. They even, as in children, gardeners or other shokunin, do not respectively look out for them. They, do not only accept well-fitted, according to their human size, designed objects and provided solutions. They use them without hesitation.

> Not only the skin, but all of our organs of perception might be said to possess some form of knowledge. (Classen 2005: 28)

Such as bodily intelligence, it is clear, is not only a matter of physiological data-gathering, but of uniting perceptions with moral and cosmological values. While knowledge of the world may be said to come from many bodily channels, the sense of touch is a particularly diffuse and varied source of information. A person may be immersed in tactile sensations, enveloped by the wind or by heat, yet at the same time register minute, local perceptions, the tickle of an insect or brush of a leaf. If sight worked this way we could see the blue expanse of the sky, and at the same time be looking at grains of sand on the ground. The author recognises another line of thought, a common thread, between Classen´s characterisation of bodily channels (2005: 28) and the property of physical traces previously discussed. Tracage on objects are based on formations, which are broad, unspecific and rich, and those formations are derived from sources (of information), which are versatile, diverse and consistently inhomogeneous. If then, to follow the thread between perceived body knowledge and, in consequence to, the alteration of body surfaces by mechanical factors, the information embedded in the exterior of objects or can be solely perceived by the sense of touch. The simple reason lays in the technical fact of invisibility.

The author argues that in order to understand, interpret, and subsequently develop traces into knowledge, the technique of cartographical skins, introduced earlier in this chapter is a valid method to be applied. The mapmaking approach benefits from a constructive spirit to reveal human condition through the evidences of traces, avoids possible misinterpretation, caused or derived from illegibility of traces i.e. subtle, minimal or ad-hoc, and diffused by an inappropriate technical medium to record and capture indistinctness of data sources (Hypothesis). The research practice takes and builds on exactly the issues mentioned above on invisibility, fading and diffuseness of signs of touch and developed a strong argumentation by using a touch-sensitive skins of objects to deal with the problem.

3.11 Knee-high, skin-deep and walk-on-able and run-over-able

This paragraph underlines the fact that physical matter or human actions are bound to gravity and so are the production of traces. This aspect becomes relevant to the interpretation of traces on objects or environment.

Although the earth´s surface skin must be described focussing on the human size, in juxtaposing to Gibson (1986: 127) not as flat, even and straight in terrestrially quality, but in turns convex and concave, moves up and down, make twists, turns and winds. However due to the matter of human scale, alterations in spatiality and localisation, in height above

sea level or as abyssal valley, are barely noticeable by human and non-humans and their embodied senses or sensuous bodily organs. Referring to the categorisation of traces, horizontal surfaces are designated, yet predetermined to generate, keep and store traces of wear, due to gravity by accretion, deposition or abrasion. All kind of signs of traces: particles, grains, dust, water, raindrops, leaves and so on will naturally rest on flat surfaces relatively to the centre of gravity.

> If a terrestrial surface is nearly horizontal (instead of slanted), nearly flat, (instead of convex or concave), and sufficiently extended (relative to the size of the animal) and if its substance is rigid (relative to the weight of the animal), then the surface affords support.
>
> [...] It is a surface of support, and we call it a substratum, ground, or floor. It's stand-on-able, permitting an upright posture for quadrupeds and bipeds. It is therefore walk-on-able and run-over-able. It is not sink-into-able like a surface of water or a swamp, that is, not for heavy terrestrial animals.
>
> [...] The human species in some cultures has the habit of sitting as distinguished from kneeling or squatting. If a surface of support with the four properties is also knee-high above the ground, it affords sitting on. We call it a seat in general, or a stool, bench, chair, and so on. (Gibson 1986: 127-128)

Conclusion

As a conclusion of this chapter on the relationship between surface, touch and the user, and the distinguishing approach between surface-less volume, e.g. the meaning of a cup containing air and volume-less open set of surfaces, it can be argued that scale of the surface, and therefore the proportion to human or non-human (animal´s) size, is the most influencing factor. Scale is significant not only for the production of surface touch/ contact but for the activation of perceptual cues and human behaviour with man-made objects. The earth´s skin is meant to act as walk-on-able or run-on-able (Gibson 1986), in opposition a dial to be turned and a virtual button to be pushed and dragged. It is argued and concluded that able-bodied actors, in particular adults, hesitate to engage with surfaces by touch to gather information about the meaning of matter related to surface experiences. Materiality of the object, and the corresponding materiality of its surface, deals with the way human touch and physical contact is received by the object´s core. A soft object affords to be pressed or to be jumped on; a rigid sharp-kinked solid or volume seems to insist being cut with an axe into two halves, for instance.

Another conclusion is established in the case the object and ergo the surface is dead (Howes 2005), senseless or unconscious (or treated as dead) - in juxtaposition to an object which is alive and active - surfaces store information and are important evidence of human occupation. The information embedded in the skin is comparable to other skins and therefore provides knowledge about the differences in user behaviour with the object. Removing substance from a solid, exposing sub-surface material, can be described as a person´s own liability to, firstly, engage bodily with the object and secondly to make a permanent, deliberate and embodied commitment to a material surface. The action of mark-making can be interpreted, thirdly, as the urge to preserve a moment, an event, an occasion, or the relationship to a specific person, location, setting or time. For instance, traces such as imprints on the beach or in a soft grounds of a hill walk left non-intentionally, an engraved symbol or text written (a love heart) with intention in the sand or on the fossilised teeth of mammals (McPhee 1981) are considered as significant and relevant forms of human (or non-human) traces because firstly the process of making them involves a set of deliberate human actions, and secondly the duration and existence of those signs depend on time, enabling or facilitating a reconstruction of past events and historic properties.

Main conclusion

The theoretical discussion has provided valuable insights into the human condition and the encounter, contact and usage of objects. The following paragraph summarises arguments on material properties, technical requirements and materiality, and the importance of materiality in design. The material (and choice) of objects is derived and dictated by mainly their properties and technical variables (chemical, electrical, atomic, environmental, magnetic, acoustical etcetera), for instance the strength of a wooden handle or a protective surface finish of a chair base. The theoretical analysis of affordances (Gibson 1977, 1979, 1986; Norman 1988, 1999, 2011) of materiality and material objects does not generally influence the process of design in practice (Lawson 1980, Schön 1983, Cross 2001).

The impact and effect of materiality on the actor´s behaviour remains, in design and development at least, underestimated and registered to a minor degree towards aspects such as the desirability of consumables, durable goods, and the purchasing decisions of actors, users, customers or consumers. Materiality - surfaces, touch, smell or odour - as a means to influence (specific) behaviour, elicit former experiences, and therefore strongly influence biased decision-making, is of secondary importance on the design agenda. Material choices are dictated by the physical properties of materials rather than the actor's individual reaction towards the material and behaviour in response to the material (Kondo 1990, Pinney 2001).

It is primarily important and meaningful to understand what a material does, how it works, how long it withstands human impact, how durable it is, how rigid or brittle (hardness) it is, how heavy or light it is, etcetera. In summary: the design material´s properties, qualities or variables are defined by these and other numbers, facts and figures and not, as discussed in chapter 2 it would be more reasonable to proclaim, by the meaning defined by different actors. Second, but no less relevant, important or significant, is how matter or material can be processed, shaped, formed and deformed, prototyped, recycled and further manipulated, transformed or translated with a specific aim or into a specific shape. In addition to the material variables comes manufacturing properties such as castability, the behaviour, quality and ease of the material during casting, and its machinability. The act of processing creates an impact and builds, adds and changes the value of the object towards the term of personhood, emotional ownership or affection. In agreement to other scholars in the context of personhood (Appadurai 1988, Mouto 2007, Strathern 1999, Fowler 2010) and objects (Baudrillard 1975, 1996; Winner 1980, Gibson 1986, Norman 1999), the author concludes that a hand-made object, a sculpture for example, seems to be far more desirable and triggers a far deeper affection by an actor in comparison to a rapidly produced object machined by a robot, such as a 3D-printed object made from a powder, wax or liquid resin. The matter of the short production time, the disembodiment engaging with physical solids, forming shapes and primarily the lack of touching the material itself and above all the tight fence between the maker and the material are aspects that built the estrangement to an object manufactured by a machine. Thus the act of designing, applying a form to something, is dictated by the need to be a highly-skilled CAD models in order are successful with the result.

The insights and understanding developed through the theoretical discussion at this stage has supported the author´s point of view towards the design of touch-sensitive objects in general. In retrospect, the close tie and interlock to the insights provided from theorists such as Gell (1998), Gosden (2004, 2005), Ingold (2007, 2008, 2009, 2010), although (fractionally and superficially) disrupted in some subjects, enabled the author to review, reflect and evaluate the research practice (in theory) according to the understandings gained by angles of theoretical view. These new views towards the research practice are summarised in the theoretical review. Questions such as `What might be made differently if this updated version or part of the theoretical input would have been developed earlier in the project, prior to the decision made in developing the prototypes?´ have been generated throughout the theoretical studies. Theoretical knowledge was developed fragmentarily, intuitively, and in an ad-hoc rather than a systematic manner. However it is of an equal

level of significance to the knowledge gained through practice, by doing and making, which, although completed earlier, the author agrees with Norman (1999), Lawson (1980), Schön (1983) and Cross (2001) and considers as equally significant. The broadening of theoretical discourse and the engagement with other scholars, sources of documented data, written information and further literature, has substantially informed and completed the author´s knowledge on the topic.

Has the author included the knowledge gained through the theoretical discussion of the demands of children and objects? Referring to Latour's work, how might an `automatic door groom´, or a set of speed bumps, act, look and feel like if created and built by a designer, particularly one paired with a sound, profound theoretical knowledge? Current design solutions, such as an automatic door groom, is rather driven and influenced purely by practical, functional, economic and ergonomic factors. The automatic door groom described by Latour was a product created and built by engineers evidencing a lack of human-centred perspective, or by non-human-centred architects or planners, and only loosely connected to user-centred considerations and evaluations.

The knowledge generated through literature on philosophy and material culture feeds more into the practical discourse of product design and in particular the design of technology simulating physical events. As mentioned previously and above, it is fact that, in product design, the significance of surface touch is a minor priority and is of secondary importance within the decision-making process of design. The reason for this is primarily because of the lack of evidence of the importance of material touch in comparison with the product´s appearance when a product is face-to-face with an actor, and also the lack of evidence of the importance of material touch in determining the overall desirability and attractiveness of the product. More relevant material properties such as flex and wear resistance, or overall durability, appear to be of greater importance and more influential, at least from an economic and consumer's point of view. But there is no doubt that the theoretical input from reviewed literature would have a significant impact on the design of objects.

In design practice the choice of the most relevant material, for a part or component, is commonly driven by material properties and not by touch experiences. The theoretical discussion has provided evidence about the main, positive, relevant impact of human (physical) touch with objects and the potential of materiality within the meaning of objects and things.

The field of surface touch becomes even more significant in the design of software skins due to the flatness and sterility of screens and the important role to act as an interface between virtual objects (or data) and the human body. The area of tactility (the point of the physical, bodily interaction) is reduced to a minimum. The maximum area of finger contact of 10mm by 10mm results from the small size of the screen relative to the human body and its available inherent physical capability. Working with computer screens is dictated by lack of physical touch and bound to the attempt to simulate material touch through simulated tactile experience and feedback. Aligning with scholars such as Classen (2005), Uexküll (1982, 1996) and Mouto (2007), actors in particular adults avoid engaging and impinging with surfaces through which a commonality can be drawn to the predominance and affection of software skins. For example, a virtual tool such as a hammer displayed on screen in two dimensions is in reality composed of a solid wooden handle, a forged iron cast and splint made from (a different) hard wood, and addresses the actor´s intuition and invites them to touch, grip, hold, act upon and use the object for the intended task. The actor´s tactile experience is hereby strictly limited to the flatness and smoothness of the glass surface and the attached clinical value. In opposition to the validity of the object on a touch screen, the actor´s full bodily engagement, the embodiment with the object and its real contact and use remains complex, difficult and non-existent. The notion of virtual objects, their impacts and meanings for different actors is not discussed to full extent by existing literature or by scholars such as Latour (1987, 1992, 1999), Gell (1998), Ingold (2007, 2009), Gosden (2004), Norman (1999), Gibson (1986) and Winner (1977, 1986). This is presumably due to the fact that display design and game technology is a relatively

new area in the field of materiality, tied to constant change and reinvention of the product, field and discipline itself. Continuing questions, in addition to above enquiries, are in which way is reality rendered in affordance theory, and, how can the concept of perceived affordances (Gibson 1977, 1979; Norman 1988, 2011) be applied to virtual objects, which differ in size, appearance and shape, and, how can this be explained and defined within the context of designing objects? Comparing the difference between software skins to the tactility of object skins, transferring the knowledge developed through the user experience with computer skins, with its complex data, to objects skins with zero screen content or hardly any `skin data´, the author considers for his research practice the skin of objects as a valuable input-giver about the real use of task-orientated actions.

The question of the authority (Latour 1993) and politics (Winner 1980, 1986) of the object´s materiality both, virtual and real, can be affiliated at this final stage of the research project. Although the skins from objects are rarely actively involved in the interactive process, despite it delivers stimuli via an interface or buttons, it remain passively once the actor has understood and acted upon the object´s signs or messages it offers. In conclusion, and after completion of the theoretical analysis, the dissertation calls design practitioners firstly to be aware of relevant literature on materiality and secondly to engage more closely, carefully and confidently with precedent literature on materiality, first and foremost during practical work, and also in design decision-making. Thirdly, design practitioners might have to build the confidence to rely on words, arguments and written conclusions rather than purely referring to and relying on personal conclusions drawn through their own process of doing and making, or through findings from other practitioners.

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Praxis

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Überleitung zu `Pressure-sensory matrix´

Die Ergebnisse der Anwendung der Spurensuche - als primäre Phase der Ideenentwicklung in Designprozessen und als Methode der Erkenntnisgewinnung und ergänzende Methode des nutzerorientierten Designverfahrens - bestärken den Autor in seiner Überzeugung, diese neue Methode in seiner Forschung vertiefend fortzuführen. Es wird dabei von besonderem Interesse sein, Verfahren zur Spurensuche und Spurendecodierung (Definition) zu entwickeln, die speziell in Produktentwicklungsprozessen einsetzbar sind. Der Fokus des Autors liegt dabei auf der Absicht, ein Verständnis darüber zu erlangen, welche Nutzer hinter den Spuren stehen oder welche Menschen diese verursacht haben. Die Hypothese soll diskutiert und validiert werden, ob es mit einem in absehbarer Zukunft zu entwickelnden Verfahren möglich sei, eine entsprechende Decodierung (Analyse) der Spuren - mit dem Ziel, Nutzergruppen eindeutig zu definieren - vorzunehmen.

Die Relevanz der Spurensuche für die weitere Forschung

Für die weiteren Ziele innerhalb des Forschungsvorhabens ist es bedeutend, den Fokus geschärft auf die allgemeinen Gebrauchsspuren und den taktilen Umgang mit Produkten zu legen und in der Praxis „Formen der Automatisierung“ zu entwickeln. Die Entscheidung (über die Wahl des Fokus und) über die Eingrenzung des Forschungsfeldes stützt sich auf folgende Begründung: Der Autor hat mit der intensiven Auseinandersetzung mit dem Thema innerhalb seiner Feldstudie und mit der Validierung der Methode durch eine neutrale Anwendergruppe (Studenten) bewiesen, dass die Spurensuche ein wünschenswertes und gefragtes Werkzeug in nutzerorientierten Designprozessen werden kann, unerschöpflich neue Impulse und Input liefern kann und insbesondere die Spurendecodierung ein hohes Maß an Entwicklungspotential in sich birgt. Die Frage, die der Autor im weiteren Verlauf seines praxisorientierten Teils diskutiert und beantwortet, ist die, ob Beobachtung und Decodierung von Spuren sich speziell eignen, um bei inklusiven Designentwicklungen ergänzend zu etablierten Methoden sinnvoll Abhilfe zu schaffen.

Im weiteren Verlauf soll - mit dem Ziel, Methoden zu entwickeln und zu gestalten, die es ermöglichen, Berührungen (diese sind eine Form von Spuren) lesbar darzustellen - an unterschiedlichen Methodenansätzen auf Basis einer praktischen und technischen Ausrichtung geforscht werden. Weiterführende Fragen: An welcher zeitlichen Stelle ist der Einsatz der Spurensuche und Decodierung während eines Designprozesses sinnvoll/ geeignet? Kann die Methode, nachdem eine Vorauswahl einer bestimmten Zielgruppe getroffen wurde, zum Einsatz kommen und insofern Entstehen, Herkunft und Vorkommen von Spuren an Testobjekten regulieren/ leiten? Wie und vor allem - im Hinblick auf Inklusion oder eine Minimierung der Exklusion mit dem jeweiligen Produkt - nach welchen Kriterien können relevante Nutzer ausreichend informiert ausgewählt werden (Usabilty-Test)?

4. Überleitung von der Spurensuche zu der Gestaltung eines berührungssensitiven Serienprodukts

4.1 Einleitung und Überleitung

Die Oberfläche von Produkten oder Umgebungen soll durch das Auftragen oder Anbringen einer Messhaut oder Kontaktfläche für ein direktes, in Echtzeit ablaufendes Ablesen der Nutzung sorgen. Diese Vorgehensweise können wir als gezieltes Hinterlassen von Spuren der Handhabung und deren Auswertung in Form einer “Spurensuche” als neuen Ansatz des Inklusive Designs bewerten. Die Spurensuche wurde als Methode des nutzerzentrierten Designs im Rahmen eines Studentenprojektes getestet. Die Ergebnisse der Anwendung geben den Anlass dazu, die Entwicklung einer Methode, basierend auf einer Untersuchung der Kontaktoberfläche von Produkten, fortzusetzen.

Eine Erkenntnis dieser Methode/Spurensuche war die der Ideengenerierung durch die Impulse von latenten Spuren. Ein zweiter Aspekt wurde durch die Anwendung selbst deutlich: Es entstand das Bewusstsein, dass Spuren allgegenwärtig und universell sind. Auch Rathje (1979, S. 78 f.) stellt mit der Omnipräsenz von Spuren und deren Herkunft eine inhaltliche Verknüpfung zum Universal Design her.

> Material traces are ubiquitous and readily available for study. Trace measures are usually nonreactive and unobtrusive. Since they are applied after behavior has occured they do not modify behavior they seek to study.

Eine weitere Faszination der Spurensuche als Methode ist der Umstand, dass in die Untersuchung – aufgrund der indirekten Präsenz der Nutzer – nicht direkt einfließt, woher die Spuren im Grunde kommen, von welchen Personen sie verursacht wurden oder aus welchen Situationen sie stammen. Diese Erkenntnis lässt die Spurensuche für den Ansatz der Inklusion im Produktdesign interessant erscheinen. Es ist dabei zu beachten, dass natürlich nur die Spuren von Menschen berücksichtigt werden können, die das Produkt angefasst oder benutzt haben. So hindern – im Sinne des Universal Designs – physikalische und psychologische Barrieren Menschen daran, Produkte zu verwenden und infolgedessen können die Menschen, die ausgegrenzt werden, auch keine Spuren hinterlassen. Somit bleiben sie auch weiterhin bei der Methode der Spurensuche unberücksichtigt. Wenn wir nun von einer Universalität von Spuren und deren Allgegenwärtigkeit sprechen, so muss man dabei bedenken, dass Spuren an Produkten nicht ein Abbild des Nutzungsverhaltens der ganzen Gesellschaft sein können. Die Spuren stellen jedoch eine breitgefächerte Matrize von menschlichen Interaktionen dar, deren Tragweite eine andere Methode, beispielsweise eine über einen bestimmten Zeitraum vorgenommene Nutzerbeobachtung, nur schwer erzielen könnte. Die Diskussion über eine Decodierung der Spuren durch Abrieb, Abnutzung oder durch Abdrücke im Material oder in der Oberfläche, gilt es nun – mit dem Ziel des Designers, den realen Gebrauch von Produkten zu verstehen – durch die Entwicklung einer neuen fortgeschrittenen Methode (Praxis 3) zu verfeinern, den Ablesevorgang des Spurenlesens zu digitalisieren und Berührungen dynamisch, gespeichert oder in Echtzeit darzustellen.

Mit der Entwicklung von physikalischen Vormodellen in der Phase „Experiment (1) der Praxis (3)“ will der Autor vorrangig die Möglichkeiten der technischen Komponenten überprüfen und beurteilen, ob die derzeit verfügbaren Komponenten für die definierten Forschungsziele, Anwendungen und Testreihen geeignet und uneingeschränkt einsetzbar sind. Hierbei geht es vor allem darum, Grenzen der Technik auszutesten und Bereiche für Experimente zu definieren. Der Autor beabsichtigt ein physikalisches Testmodell mit folgenden Leistungen und Eigenschaften zu entwickeln und zu gestalten. Es soll

1) Berührungsdaten aufnehmen und intern in einem Computer (CPU) speichern und/ oder drahtlos senden,

2) dreidimensional ausgeformt sein,

3) dynamisch, in Echtzeit oder mit einer Speicherfunktion arbeiten,

4) über eine feine Sensormatrix verfügen, die in der Lage ist, auch kleinflächige

und subtile Berührungen zu erkennen (Körpergrößen),

5) eine mapping Sensorfunktion innehaben, mit der es möglich ist,

Positionen der Berührungen auf der 3D-Fläche zu lokalisieren und

6) Daten zu visualisieren (CPU)

7) reproduzierbar sein.

Das Leistungsverzeichnis soll in dieser Phase bei der Entwicklung eines physikalischen Testmodells helfen. Der Fokus der Phase „Testmodell“ liegt darin, ein Verständnis und ein Gespür für die Möglichkeiten der Sensortechnik aus Sicht eines Designers zu entwickeln.

4.2 Planung, Format und Durchführung (Versuchsmodell/ Technologieträger)

In der Phase „Experiment (1) der Praxis (3)“ sollen mehrere Versuchskörper als Testmodelle entwickelt werden, die unterschiedliche Größen und Ausformungen haben. Die Phase „Experiment (1)“ hat das Ziel, das Zusammenwirken von Sensorik, CPU und Vernetzung zu testen, und birgt in sich die Idee, mit Hilfe gleicher Messtechniken unterschiedliche Verhaltensweisen der Nutzer verdeutlichen zu können. Zur Überprüfung der Messtechniken variieren die Anzahl, Anordnung und Dichte der Sensoren bei den Testmodellen. Um in dieser frühen Phase zu einem aussagekräftigen technischen Konzept zu kommen, empfiehlt es sich, eine Matrix zu entwickeln, die schichtweise aufgebaut ist. Die Berührungsmatrize besteht sowohl aus Zeilen als auch Kolumnen aus leitfähigem Garn mit einer Mittelschicht aus einem piezoresistiven Material (*Velostat is a piezoresistive material, meaning it’s electrical resistance decreases when pressured*). Die Testmodelle haben die Aufgabe, Daten von Berührungen (Position/Druck) zu erfassen, zu speichern und/oder zu senden. Es wird beabsichtigt, die ermittelten Daten mit Hilfe einer Anwendung dreidimensional und dynamisch darzustellen. Die Visualisierung der Daten soll den Designer über Gebrauch und Nutzen der Testmodelle informieren. Dazu sollen die Testmodelle einem größeren Publikum zugänglich gemacht werden oder ein Szenario entwickelt werden, bei dem Personen eingeladen werden, die Testmodelle zu berühren. Das Arbeiten mit dem und das Überprüfen des o.g. Leistungsspektrum, verlangt nach einem zwei oder mehrschaligen Gehäuse, das sich durch einfache und schnelle Zugänglichkeit und Transparenz der Technik auszeichnet. Aus diesem Grund wurde die Entscheidung getroffen, entgegen der Eingangsthese *“[...] ein Produkt als Satellit zu gestalten, das die Messkomponenten versteckt und sich nicht als Messinstrument erkennbar zeigt”* die Technik für den Nutzer sichtbar zu gestalten. Dieser Umstand widerspricht in dieser Entwicklungsphase keineswegs den Zielvorstellungen des Autors. Das Testmodell soll in erster Linie Erkenntnisse über den Stand und den Spielraum der Technik liefern, innerhalb derer der Autor die technischen Möglichkeiten ausloten und wenn notwendig, den Bedürfnissen der anstehenden Forschung anpassen kann. Nach derzeitigem Kenntnisstand sind mittelfristig verfügbare Sensormatten für die geplante Anwendung dieser Forschungsarbeit nicht geeignet. Die Auflösung von sensory fabrics ist, so vermutet der Autor, nicht fein genug, um kleinflächige Berührungen oder subtile Tastvorgänge zu erkennen.

Da der Autor von den Absichten seines ursprünglichen Forschungsvorhabens, ein Messsystem mit hoher Toleranz zu entwickeln, nicht abrücken kann und will, nur weil der derzeitige Stand der Technik diesbezüglich wenig erfolgversprechend ist, entschloss sich der Autor im Rahmen seines Praxisvorhabens, an der Neuentwicklung einer Sensormatrix

zu arbeiten, die den Ansprüchen und Anforderungen des Projektziels entspricht und diese berücksichtigt. Die Dimension der Alltagsproduktwelt, mit denen der Produktdesigner arbeitet, wird durch die Messtechnik nicht berücksichtigt. Es wäre wünschenswert, Mess- und Testverfahren an den Umfang der physikalischen Produktwelt anzupassen. Somit sind die Forderungen nach einem akkuraten, auf Feinheiten ausgerichteten Messsystem alleinig auf den Dimensionen begründet, mit denen sich der Produktdesigner beschäftigt. Die feinste sensory fabric, die im Handel erhältlich ist, besitzt eine Auflösung von 10 x 10 mm. Insofern würde eine Fingerberührung – ein leichtes Antippen auf einem Punkt auf der Fläche – gar nicht erkannt werden; eine ganzflächige Berührung einer Hand oder eines Haltegriffs würde dagegen bei einer Messung Berücksichtigung finden. Für die Darstellung der Daten der Testmodelle ist der Anspruch lediglich der, dass die Berührungen in Echtzeit und ohne Störungen sichtbar verdeutlicht werden. Die Datenvisualisierung kann zweidimensional, graphisch und diagrammartig sein, da es in dieser Phase in erster Linie darum geht, den Input/ Output der Messfläche im Computer abzulesen. Die Darstellungsmethode soll die Feinheit der Messmethode wiederspiegeln.

4.3 Hauptziele der Praxis 3 – Experiment (1)/ Experiment (2)

Der Designer übernimmt in der Praxis die entscheidende Rolle eines Gestalters von haptischen Objekten und die Rolle des Sozialforschers zugleich. Die Entwicklung eines Produktsatelliten, der Daten zum Empfänger (Designer) zurücksendet, verbindet die Disziplinen Sozialforschung und Design im Sinne einer neuen Form des “in-den-Umlauf-Bringens” von Serienprodukten als cultural probes. Der Autor erhält somit aus erster Hand aktuelle Daten über die tatsächliche Handhabung von Produkten, und zwar dynamisch, gespeichert oder in Echtzeit. Die Idee in Praxis 3 versteht sich als sinnvolle, auf die Beantwortung der Forschungsfragen abzielende Weiterentwicklung der Spurensuche, in einem digitalisierten und dynamischen Format, das beabsichtigt, den Umgang von Produkten in der Realität und die Verbindung zu nutzerzentrierten Gestaltungsmethoden zu überprüfen. Ein in ein Produkt integriertes Messystem hat den Auftrag, den Gebrauch von Produkten zu registrieren und die Vorgänge und Abläufe für den Designer in Echtzeit abzubilden.

In der Phase „Experiment (1) der Praxis (3)“ soll überprüft werden, welche Art von Messgrößen welche Aussagen über die Interaktion treffen können – immer mit der Absicht, den Umgang mit Produkten lückenlos zu verstehen. Der Autor vermutet, dass Berührungssensoren die Aufgabe übernehmen, relevante Daten über die Nutzung von Produkten zu liefern. Die Informationen über Berührungen (Stärke/Dauer) können mit Daten der Position gekoppelt werden, die verraten würden, an welcher Stelle der Oberfläche der Nutzer zu welcher Zeit das Produkt berührt und wie viel Kraft dabei im Spiel ist. So könnte die Methode Aufschluss darüber geben, ob kleinere Hände an bestimmten Stellen des Produkts oder bei bestimmten Aufgaben mehr Kraft aufwenden müssen als große. Grundsätzlich wäre es für das Verständnis des Designers interessant und für den Gestaltungsprozess im Rahmen des Inklusiven Designs relevant zu wissen, welche Bandbreite das Produkt bietet und ob die beteiligten Benutzergruppen als heterogen beschrieben werden können. Ein Messsystem könnte über den tatsächlichen Gebrauch Aufschluss geben und wiedergeben, welche Benutzergruppen am Umgang maßgeblich beteiligt waren.

Der Autor sieht vor, über die Entwicklung und Herstellung eines datensendenden Objekts die Untersuchungsmethode der Spurensuche im Umfeld des Produktdesigns zu überprüfen. Dabei soll in verschiedenen Entwicklungsphasen schrittweise festgelegt werden, in welche Richtung das endgültige Modell und die abschließende Praxisanwendung gehen kann. Dieses Modell sieht vor, ein physikalisches Produkt zu schaffen, dass die Funktion eines in den Umlauf gebrachten, datensendenden Satellit übernimmt, ohne das Erscheinungsbild eines Serienproduktes zu ändern. Für die frühe Phase der Praxis sieht der Autor vor, anhand von physikalischen Testmodellen, die Messtechnik zu überprüfen. Die Frage, die

zu Anfang beantwortet werden muss, ist, wie dicht die Messpunkte auf der Kontaktfläche gesetzt werden müssen (matrix resolution), wenn sie relevante Messdaten über die Nutzung liefern können sollen. Wie der Autor in seinen einleitenden Forschungsfragen erwähnte, ist das Ziel der Untersuchungsmethode, zwischen Benutzergruppen mit unterschiedlichen Körpergrößen unterscheiden zu können. Die Methode soll in der Lage sein, den Autor und den Designer darüber zu unterrichten, ob das Objekt von einer kleinen oder von einer großen Hand berührt wird und in welchem Maß eine Annäherung an das Objekt überhaupt stattfindet. Für diese Art der Berührungsmessung ist es nach derzeitigen Erfahrungswerten notwendig, eine feinmaschige Sensor-Matrix zum Einsatz zu bringen. Auch ist der Einsatz von Messsystemen in komplexen Körpern und das Ablesen von Daten von einer dreidimensionalen Oberfläche weitgehend unerforscht.

Die Frage, ob es möglich sei, mit Sensoren menschliches Verhalten ablesbar zu machen, ist unumstritten (physical computing). Die Frage jedoch, ob man mit mittelfristig verfügbarer Sensortechnik und deren Integration in ein Serienprodukt menschliches Nutzungsverhalten dokumentieren kann, muss im Laufe des praktischen Teils beantwortet werden.

Darüber hinaus hat diese Forschungsarbeit die Absicht, Erkenntnisse dahingehend zu erzielen, ob Designer und alle am Designprozess beteiligten Akteure unter Einsatz angemessener technischer Mittel, den Umgang mit Produkten besser verstehen lernen und dieses Verständnis nutzen können, um Produkte besser, menschlicher, barrierefrei und universaler zu gestalten. Vor allem soll die Frage in den Vordergrund rücken, ob die Sensorik den Autor dabei unterstützen kann, ein Produkt zu entwickeln, das losgelöst von jeder Laboratmosphäre relevante Daten über den tatsächlichen Gebrauch liefern kann. Die Methodik eines berührungssensitiven Produktes kann dazu beitragen, den Designprozess integraler ablaufen lassen zu können. Diese Vorgehensweise impliziert, dass ein inklusiver Designprozess zur Gewinnung von inklusiven Produkten förderlich ist.

Der Fokus der Phase „Experiment (2) der Praxis (3)“ richtet sich auf zwei Hauptziele und Fragen.

1) Kann die Vorgehensweise Daten generieren, die Verhaltensweisen, denen unterschiedliche haptische Berührungsvorgänge zugrunde liegen, differenzieren? Sind die erworbenen Daten geeignet, Nutzungsverhalten unterscheidbar und ablesbar zu machen, um daraus Nutzungsszenarien zu rekonstruieren?

2) Mit dem Ziel inklusive Designentwicklungen durch überprüfbare Nutzungsdaten zu optimieren, soll die angestrebte Entwicklung mittels der vier unten aufgeführten Schritte zu einem Optimierungswerkzeug des Inklusiven Designs führen:

1. Aussagekraft der Daten

2. Differenzierung der Daten

3. Identifikation des taktilen Umgangs mit dem Objekt

4. Auswertung der Daten

    4.1 Bewertung der Interaktion zwischen Objekt und den

    anthropometrischen Eigenarten der Nutzer

    4.2 Versuch der Einstufung in Bedürfniskategorien

    4.3 Identifikation der Handhabbarkeit von Komfort und Unbequemlichkeit

Die Frage, die sich im Anschluss stellt, ist, ob man durch diese Methode die Forderungen der Nutzer im Dialog mit dem Designer geltend machen kann.

4.4 Formgestaltung der Testmodelle der Phase „Experiment (1)“

Die Testmodelle haben die Aufgabe, taktile Berührungen von Nutzern lesbar zu machen und die Frage zu beantworten, wie sich Berührungen von dreidimensionalen Körpern auf einer zweidimensionalen Fläche, dem Computerbildschirm, abbilden lassen. Die Testobjekte sollen dabei wertfreie Trägersysteme für die taktile Berührungsmessung sein. Form und Größe der Testmodelle werden grundsätzlich durch das Bestreben nach einer universalen Handhabbarkeit sowie durch die Notwendigkeit der Schaffung eines Volumens (Bauraum) für die integrierten Komponenten definiert. Eine universale Handhabung kann erreicht werden, wenn Menschen mit unterschiedlichen Körpergrößen oder Körpereigenschaften im selben Maße, ohne Nachteile zu haben oder von Barrieren behindert zu werden, mit dem Objekt umgehen können. Es ist vorgesehen, mehrere geschlossene Volumenkörper zu entwerfen, mit Hilfe derer der Nutzer leichte Aufgaben einhändig oder beidhändig erledigen soll. Dementsprechend wäre für das Interagieren mit dem Objekt eine Größe, die sich an den Dimensionen von zwei Händen orientiert, von Vorteil.

Der Autor beabsichtigt die Entwicklung von wertfreien Formen mit neutraler Aussagekraft. Die Testmodelle sind lediglich Platzhalter oder Technikträger ohne produktsprachliche Funktion. Mit ihnen beabsichtigt der Autor das Potential unterschiedlicher Sensortechniken zu testen und das jeweilige Leistungsvermögen zu vergleichen. Die Gestaltung wertfreier dreidimensionaler Körper kann nur begrenzt stattfinden, da eine komplette Anonymisierung von Körpern wahrnehmungstechnisch unmöglich ist. Der Autor beruft sich im Prozess der Formfindung auf die Pragmatik, die technischen Komponenten in einem Volumenkörper unterzubringen und für den Forscher direkt zugänglich zu gestalten. Die Testreihe soll Modelle unterschiedlicher Ausrichtung und räumlicher Orientierung enthalten, wobei ein vertikal und ein horizontal ausgerichteter Volumenkörper zur Serie gehören soll. Der Hintergrund für die Ausrichtung und Komposition der Volumenkörper liegt in dem Bestreben des Autors, die Nutzer zu motivieren, mit dem Testmodell taktil Kontakt aufzunehmen und letztlich praktische Aufgaben mit den jeweiligen Testmodellen zu erfüllen.

Der Autor vermutet, dass unterschiedlich ausgerichtete Objekte verschiedene Formen der Berührung seitens der Nutzer hervorrufen könnten. Der Forscher ist vor allem an voneinander abweichenden Daten interessiert, da diese ein guter Ausgangspunkt für die Überprüfung der Sensortechnik im Hinblick auf das endgültige berührungssensitive Serienprodukt wären. Der Prozess der Formfindung und die Suche nach einer neutralen Formensprache versucht die Formästhetik bewusst auszuklammern. Das Ziel der Formensprache der Testmodelle ist es, lediglich durch eine Hülle den Bereich der Sensortechnik vor äußeren Einflüssen zu schützen. Die Kontaktoberfläche, die durch die Berührungshülle gebildet wird, soll ansprechend gestaltet sein und für den Nutzer einladend wirkend, das Objekt zu berühren. Die Testmodelle sind lediglich Werkzeuge oder Instrumente zur Datengewinnung und reine Testkörper (guinea pig), die zur Überprüfung der Idee der dreidimensionalen, taktilen Berührungsmessung dienen.

4.4.1 Computer-aided design als Instrument zur Herstellung wertfreier Volumenkörper

Der Autor sieht vor, über die Anwendung von computer-aided design Programmen eine Herleitung der Volumenkörper der Testmodelle herbeizuführen. 3D-Koordinaten, die aus Anzahl, Anordnung und Dichte der Sensoren und der Konfiguration der technischen Komponenten, die zur Verarbeitung und zur kabellosen Weiterleitung der Daten notwendig sind, abgeleitet werden, sollen als Eingabe dienen. Weitere Faktoren hierfür sind, dass

die Sensorflächen in direkter Nähe der Außenhaut des Körpers platziert werden müssen und der Körper eine geschlossene Form besitzen sollte, die jedoch gleichzeitig zu Wartungszwecken für den Forscher ohne Schwierigkeiten zugänglich sein sollte. Diese Definitionen dienen unter Berücksichtigung von waagerechten und senkrechten Achsen und einer dementsprechend unterscheidbaren Körperorientierung als Parameter für das Konstruieren der Volumenkörper. Die Anordnung der berührungssensitiven Messbereiche ist durch eine vom Computer generierte Regelmäßigkeit definiert. Es soll zudem sichergestellt werden, dass der Testkörper keine `toten Winkel´ enthält, in denen eine Berührung, ohne vom Messsystem registriert zu werden, ablaufen könnte.

Der Autor beabsichtigt, mit Hilfe von CAD-Programmen unterschiedliche Volumenkörper oder Freiformflächen zu generieren, die auf Vorgaben von Baukörpern und Aufbau der Sensorflächen beruhen und die der Frage nachgehen, inwiefern der Vorgang der Körperberechnung mathematisch zufällig ablaufen kann. Dabei können je nach Wahl der Parameter und Werkzeugeinstellungen geometrische oder organische Körperformen entstehen. Der Autor entschloss sich, den Weg der zufälligen Körperdarstellung zu gehen, um den Zwängen der Produktsemantik zu entkommen. Eine inhaltliche Belastung durch die Interpretation der Formensprache wäre kontraproduktiv, da diese Phase der Forschung lediglich das Potenzial der Messtechnik diskutiert. Väkeva (1990) schreibt über Semiotik:

> Semiotics[1] is a valid approach where something represents something else. Material objects, however, should stand by themselves and be understood within the context using previous knowledge of related objects.
>
> (Väkeva, Seppo 1990 in Semantic Vision of Design)

Das Programm der Testmodellreihe sieht vor, die Nutzer aufgabenorientiert durch die Benutzung der Testmodelle zu leiten. Diesbezüglich sieht der Autor vor, einen “Modellgarten” zu gestalten, den der Nutzer, vom Autor geleitet und beobachtet, durchstreifen kann.

4.5 Ausblick

Der Autor plant den Entwurf von dreidimensionalen Volumenkörpern ohne nutzerbezogene oder konkrete Gebrauchsfunktionen. Es ist nicht unbedingt notwendig, die Messfunktion der Testmodelle zu tarnen, denn die Überprüfung der Funktion der Messtechnik steht in dieser Entwicklungsphase im Vordergrund. Das Testmodell ist hinsichtlich seiner Größe nicht festgelegt, wobei eine handliche Abmessung von Vorteil für die Herstellung und die Anwendung wäre. Derzeit wird davon ausgegangen, dass es sich um einen zweischaligen, mit einer Sensorhaut bespannten Volumenkörper handeln wird. Es gibt die Möglichkeit, durch die Herstellung eines ball- oder kugel ähnlichen Körpers das Greifverhalten verschiedener Personen zu messen. Außerdem wäre es bei einem mit einer Messhaut umspannten Volumenkörper möglich, die Positionen von beiden Händen zu lokalisieren. Das Ziel der Technikrecherche ist es weiterhin, eine drahtlose Datenübertragung zu ermöglichen. So gilt es zudem abzuwägen, zu welchen Ergebnissen unterschiedlich ausgeformte Körper mit gleicher Messtechnik führen können. Die Vermutung, dass durch eine dynamische Formensprache auch dynamische Handlungen ausgelöst werden, soll bei der Datenauswertung aus der Testmodellphase (1) diskutiert werden. Auch in der Umkehrung dieser Theorie stellt sich die Frage, welche Berührungsmuster der Nutzer bei einer geometrischen, statischen Designsprache im Gegensatz zu einer Formdynamik anwendet. Eine Serie unterschiedlicher Objekte soll neue Erkenntnisse liefern, die Grundlage für eine zweite Testmodellphase sein könnten. Die Körper dienen vor allem als Platzhalter (spacer) und zur Bereitstellung einer haptischen Oberfläche, die Personen berühren können.Es gilt außerdem festzustellen, welche Aussagekraft die Berührungsmessung im Rahmen der Verhaltensforschung im Umgang mit Produkten einnehmen kann und ob Messungen ausschließlich durch Sensoren ausreichen, um menschliches Verhalten zu verstehen. Der Autor wird diskutieren, ob die Messergebnisse Erkenntnisse über den

realen Gebrauch von Produkten zulassen und mit welchen ergänzenden Methoden diese Erkenntnisse begründet oder widerlegt werden können. Die Frage, ob die Berührungen zu Aussagen führen, von denen sich Kriterien für eine inklusive Designentwicklung ableiten lassen, soll beantwortet werden.

Es wird vermutet, dass die Berührungsmessung mit Hilfe von Produkten den Designer dabei unterstützen können, den Umgang mit ihnen verstehen zu lernen und die Interaktionen der Nutzer besser nachvollziehen zu können. Die Berührungsmessung könnte im Umgang mit Testmodellen eine hilfreiche Designtaktik werden, die speziell für Überprüfung und Evaluation gefertigt und in den Umlauf gebracht wird. Daten von Berührungen, die aussagen, an welchen Stellen das Produkt gehalten, wie herum es gehalten wird, wie fest es gedrückt wird, wie lange es gehalten wird, sind sinnvolle Indikatoren, designrelevante Entscheidungen zu überdenken, vorhandene Lösungen zu korrigieren und/oder Varianten anzubieten.

5. Datengenerierung durch Nutzeranwendung und Entwicklung einer Optimierungsmethode im Inklusiven Design (P1-3 Entwicklung und Anwendung)

5.1 Einleitung

5.2 Fragen (allgemein)

Welche Rolle kann die Decodierung latenter Spuren (aus der Analyse der Spurensuche) bei der Berührungsmessung (decoding tactile data) spielen? Welche erweiterten Möglichkeiten kann die Spurensuche durch die Digitalisierung (Verwendung von Hardware und Software) in Produktentwicklungsprozessen bieten? Welche Erkenntnisse werden im Rahmen der praktischen Forschungsarbeit von der Berührungsmessung erhofft?

Kann die angewandte Methode auf Schwierigkeiten bei der Nutzung „greifbarer“ Produkte hinweisen? Kann durch diese Methode ein Beenden der Anwendung frühzeitig erkannt werden? Wie ist es 1. für den Designer und 2. für alle am Designprozess beteiligten Akteure (Partizipation im Industrial Design) möglich, Produkthandhabungsmuster nachvollziehbar darzustellen?

Kann der Designer dieses Wissen nutzen, um Produkte an die Bedürfnisse der Nutzer anzupassen (Ansatz d. Evaluierung)? Wie können Erkenntnisse der Studie „Berührungsmessung“ in partizipatorische Designprozesse einfließen? Kann die Berührungsmessung als Anwendungs- und Optimierungswerkzeug im Inklusiven Design dienen? Kann der Forscher die Daten der Berührungsmessung in ein Schema real ablaufender Handhabungsmuster übertragen? (Visualisierung der Daten für ein inklusives Publikum in Designprozessen?)

Wie können die Berührungsdaten mit anthropometrischen Daten sowie biomechanischen Daten sinnvoll in Bezug gesetzt werden? Sind Handhabungsmuster von Probanden mit ähnlichen Voraussetzungen (Kategorisierung: Alter, Körpergröße, Geschlecht) in einigen Kriterien (beidhändig, Kraftaufwand) deckungsgleich? Können auf Basis der Berührungsmesswerte und ihrer Analyse generelle Aussagen über Verhaltensmuster bestimmter Personengruppen getroffen werden? Kann das Wissen Designer unterstützen und in Gestaltungsprozessen Verwendung finden?

5.3 Praxisbezogene Fragen:

Mit welchen Mitteln kann ein Werkzeug der Berührungsmessung entwickelt werden, das verlässliche, überprüfbare Daten (Replikation der Messverfahren und Überprüfung der Ergebnisse) garantiert? Ist das Konzept der Berührungsmessung für die Ermittlung überprüfbarer/evaluierbarer Daten der User-Interaktion geeignet? Ist die Analyse von Videoaufnahmen eventuell schon ausreichend informativ, um ein Verständnis unterschiedlicher Bewegungsmuster entwickeln zu können?

Wenn dies so wäre, würde sich der Ansatz des Forschers und die Berührungsmessung als fehlendes Glied in der Kette der qualitativen Designforschung erübrigen. Zu welchen Zwischenergebnissen führten anfänglich entwickelte Prototypen Spehre/Globe 16 FSRs (P1) und Vert 8x8 (P2)? Zu welchen Resultaten gelangte der Autor mit der Anwendung des finalen Prototyps P3 Sensing Pot? Sind die Berührungsdaten mit den Aufzeichnungen der Videoobservation deckungsgleich? Welche Erkenntnisse beabsichtigt der Autor mit der Entwicklung und Anwendung des finalen Prototyps P3/P4) zu gewinnen?

5.4 Beschreibung der Ausgangsposition

Die Daten der Berührungsmessung sollen über den realen Gebrauch von Produkten Aufschluss geben und den Designer unterstützen, greifbare Interaktionen mit Produkten zu verstehen und insbesondere Probleme der Handhabung aufzuspüren. Es soll herausgefunden werden, ob die Methode es ermöglicht, Handhabungsmuster mit Verhaltensmustern spezifischer Personengruppen (Kategorisierung: Alter, Geschlecht, Körpergrößen, Einschränkungen, Beeinträchtigungen etc.) mittels Gegenüberstellung/ Vergleich in Verbindung zu setzen. Der Ansatz beruft sich auf die allgemein verfassten Prinzipien des Universal Designs und arbeitet auf das Ziel hin, eine Minimierung von Exklusion durch mangelhaft gestaltete Alltagsprodukte zu erreichen. Diese Form der Daten sowie die Art und Weise der Datenermittlung erhalten durch die präzise und wissenschaftliche Ermittlungsmethode einen objektiven, präzisen, neutralen und wiederholbaren Charakter (hard data). Die Methode ist im Gegensatz zu anderen Methoden des nutzer-zentrierten Designs wenig von persönlichen Sichtweisen oder Interpretationen des Forschers geprägt (soft data). Sie kann aufgrund von klar definierten Umgebungsfaktoren unter gleichen Konditionen erneut vorgenommen werden.

Es muss unterstrichen werden, dass die Methode der Berührungsmessung nicht den Anspruch hat, andere etablierte benutzerorientierte Methoden oder Teile einer qualitativen Forschung vollständig zu ersetzen. Mit seiner Diskussion und dem Vergleich verschiedener Methoden der Datenermittlung beabsichtigt der Autor jedoch, die Aussagekraft gängiger Evaluierungsmethoden in Frage zu stellen. Dies erfolgt unter der Inklusion von Nutzern und einer Minimierung der Exklusion von Anwendern aufgrund von Bedienungsfehlern. Die Methode erhebt den Anspruch, zu einem Werkzeug des inklusiven Designs werden zu können, das die Aufgabe übernimmt, die Diskrepanz zwischen qualitativen und quantitativen Erkenntnissen des Produkt Designs allgemein und speziell innerhalb partizipatorischer Designprozesse zu schließen. Wichtige Erkenntnisse werden von der Anwendung dieser bisher nicht etablierten Methode erhofft, die den Designer unterstützen sollen, menschliche Interaktion mit greifbaren Produkten besser nachvollziehen und verstehen zu können. Die ermittelten Daten der Berührungsmessung sollen den Designer darüber informieren, wie Nutzer, die sich unbeobachtet fühlen, Produkte wirklich verwenden.

Fragen im Detail

Wie können die Daten mögliche Fehler oder Frustrationen, Schwierigkeiten oder Hürden oder Barrieren in der Benutzung zeigen? Wie können Bewältigungsstrategien (coping strategies) bestimmter Nutzer ausschließlich durch die Auswertung von Daten der Berührung erkannt werden? Können die Daten die Handhabung transparenter als eine

Videoaufzeichnung aufzeichnen? Wie kann ein Verständnis für eventuelle Fehlbedienungen (mismatch von Bedürfnissen seitens der Nutzer) durch die Berührungsdatenermittlung erzeugt werden? Oder sind die Berührungsdaten in der Lage, Bedienungsfehler oder einen möglichen Improvisierungsversuch zu registrieren?

5.5 Ziele (allgemein)

Ziel der Praxisforschung ist es, mit Hilfe von dreidimensionalen, greifbaren Objekten (tangible objects) Erkenntnisse über die User-Interaktion von unterschiedlichen Nutzern zu gewinnen. Dazu sollen Werkzeuge oder ein Anwendungsgerät entwickelt werden, die/das Daten der Berührung liefern kann. Für die Anwendung wurde ein Bereich des Haushalts gewählt, der den alltäglichen Umgang mit einem Produkt simulieren soll. Die Handhabung der Objekte soll dabei nicht durch das Aussehen eines Messwerkzeuges verfälscht werden. Für die Anwendung der Werkzeuge der Berührungsmessung wurden Probanden eingeladen, die sich durch unterschiedliche Körpergrößen, Körperkräfte und in ihrem Alter unterscheiden. Im Vordergrund der Untersuchung steht das Entwickeln verschiedener Vorgehensweisen, die auf unterschiedlichen anthropometrischen Faktoren (kleine Hände/ große Hände etc.) und deren Evaluierung (Synchronisierung) durch ergänzende Methoden der Ethnographie (Videoaufnahmen mit unterschiedlichen Perspektiven zur Vermeidung von toten Winkeln) basieren sollen.

Das Wissen aus der Berührungsmessung soll mit den Erkenntnissen, die der Designer durch verschiedene andere nutzerzentrierte Methoden ermittelt hat oder ermitteln will, verglichen werden. Ob die Methode der Berührungsmessung im Vorfeld oder nachträglich angewandt wird, bleibt offen und wird zu einem späteren Zeitpunkt diskutiert. Vor allem ist der Frage nachzugehen, ob durch die Daten der Berührungsmessung und deren Exaktheit, Überprüfbarkeit und Reproduzierbarkeit, gewonnene Erkenntnisse mit den aus (qualitativen) Forschungsergebnissen abgeleiteten Informationen deckungsgleich sind. (Dazu sollen die Berührungsdaten hinsichtlich ihrer Aussagekraft und mit Blick auf den Spielraum der Interpretation überprüft und bewertet werden.) Zur Erklärung ist es sinnvoll, das mögliche Szenario eines Handhabungsmusters durch eine Illustration zu simulieren. Im Folgenden werden Erkenntnisse aus Entwicklung und Anwendung mehrerer Prototypen (P1-3) für den Erkenntnisgewinn der User-Interaktion und Inklusion (Generierung der Daten) beschrieben.

5.6 Prototyp 1 (Sphere/Globe)

5.6.1 P1 Beschreibung

Zu welchen Erkenntnissen kam der Autor nach der Entwicklung des ersten Prototyps Sphere P1 in Hinblick auf die Beantwortung der Forschungsfragen der Praxis? Folgende Begründungen, die im Laufe der Entwicklung von P1 und P2 entstanden sind, sollen die Entwicklung weiterer Prototypen der Berührungsmessung P3 rechtfertigen. Die Zielsetzungen des Artikels “Überleitung von der Spurensuche zu der Gestaltung eines berührungssensitiven Serienprodukts” geben an, welche Leistungen und Eigenschaften die physikalischen Testmodelle der Berührungsmessung besitzen sollen. Unter Punkt 4) in der Liste (Auszug siehe unten) nannte der Autor, dass das Testmodell `über eine feine Sensormatrix verfügt, die in der Lage ist, auch kleinflächige und subtile Berührungen zu erkennen (Körpergrößen)´.

Aufgrund der Tatsache, dass die Anzahl der Messbereiche aus technischen Gründen auf 16 Sensoren pro Halbkugel limitiert ist, ist der Abstand zwischen den einzelnen Sensoren zu groß beziehungsweise die Matrix der Sensoren zu “grob gestrickt”, um kleinflächige Berührungen zu bemerken und aufzuzeichnen. Diese Tatsache wirkt sich auf eine ganzflächige Sensibilisierung der Nutzungsoberfläche eines Objekts negativ aus und ist

für eine Anwendung aufgrund auftretender blind spots ungeeignet. Subtile, punktuelle Berührungen und Berührungen von kleinen Körpergliedern wie z.B. Fingerspitzen würden somit unbemerkt ablaufen, was nicht im Sinne der Anwendungsforschung liegt, da es der Anspruch ist, maximale Berührungssensibilität auf der Nutzungsfläche zu erzielen.

“7-Punkte-Plan der Testmodellentwicklung” (Stand Oktober 2012)

Der Autor beabsichtigt, ein physikalisches Testmodell mit folgenden Leistungen und Eigenschaften zu entwickeln und zu gestalten. Es soll

1) Berührungsdaten aufnehmen und zu einem Computer senden,

2) dreidimensional ausgeformt sein,

3) dynamisch, in Echtzeit oder mit einer Speicherfunktion arbeiten,

4) über eine feine Sensormatrix verfügen, die in der Lage ist, auch kleinflächige und

subtile Berührungen zu erkennen (Körpergrößen),

5) über eine mapping Sensorfunktion verfügen, mit der es möglich ist, Positionen der

Berührungen auf der 3D-Fläche zu lokalisieren,

6) Daten visualisieren,

7) reproduzierbar sein.

Ein Vorteil, der für die Verwendung handelsüblicher, vorgefertiger „FSR“ (Force Sensing Resistors) spricht, ist – neben der einfachen Handhabung – die Eigenschaft der präzisen Druckstärkenmessung mit 100g-10kg (Messbereich laut Hersteller) (100,000 kohm-1 kohm/0.981N-98N). Die Exaktheit der Druckstärke ist für ein Verständnis der Druckverteilung von Bedeutung. Die Kraft wird mit mehreren Fingern gegebenenfalls von zwei oder mehreren Händen (bei der Anwendung in einer Gruppe von Probanden) aufgebracht. Der Autor nimmt an, dass die Rückkopplung aus der Verteilung von Berührungen auf dem Körper und deren mechanische Verhältnisse zueinander eine Aussagekraft besitzt, die für das Verständnis unterschiedlicher Handhabungsmuster oder die Beteiligung und Identifizierung von unterschiedlichen Nutzergruppen verantwortlich gemacht werden kann. Der Autor vermutet jedoch, dass die Präzision der Druckmessung sekundär für die Verständnisgewinnung unterschiedlicher Handhabungsmuster sein könnte. Vor allem die (Um)-Verteilung von Positionen der Berührung (Tastbereichen/Berührungsflächen) und deren zeitliche Abfolge sollte im Fokus der Messungen liegen, da dort der Schlüssel zur Erkenntnis (in Hinblick einer Definition der Aussagekraft der Daten) vermutet wird.

In der Entwurfsphase des ballähnlichen Testkörpers P1 wählte der Autor einen Durchmesser von 200 mm. Dieser Wert scheint eine ideale Größe in Bezug auf die erwarteten Probanden

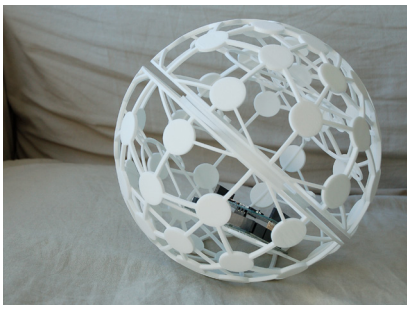


Fig. 5.1 Fragiles RP-Modell von P1

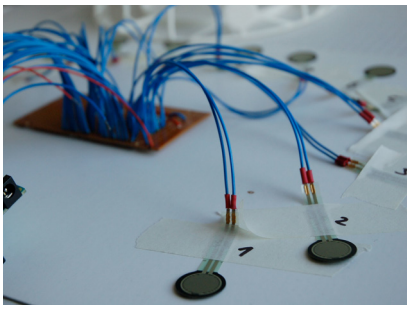


Fig. 5.2 Sensorenverdrahtung

und deren ergonomische Voraussetzungen zu sein. Ein kreisrunder Körper mit 200 mm Durchmesser kann von den wenigsten Personen mit einer Hand aufgenommen, gehalten und gefangen werden. Dieser Umstand verleitet Probanden im Allgemeinen dazu, mit dem Ball/der Kugel beidhändig zu agieren; ein Aspekt, der für die Generierung von Messdaten

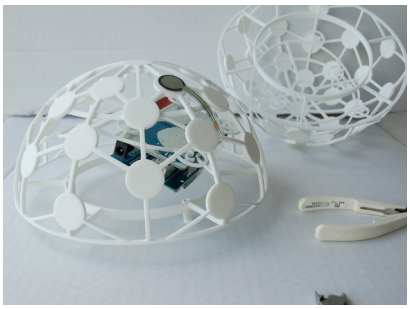


Fig. 5.3 Zugänglichkeit durch Halbschalen

auf Basis einer möglichst breitgefächerten und abwechslungsreichen Handhabung von Vorteil ist. So kann der Autor nun bestimmen, dass die Druckverteilung der Berührungen für ein Verständnis der Interaktion bedeutender ist als eine präzise Messung des jeweiligen Auflagedrucks pro Sensorbereich.

Die Verwendung einer höheren Anzahl von FSRs auch für den endgültigen Prototyp wäre durchführbar und technisch machbar, lässt man die Kosten von ca. 5,20 € pro Sensor außer Betracht. Für den weiteren Verlauf des praktischen Teils entschied der Autor, sich auf die Suche nach geeigneteren und kostengünstigeren Alternativen zu begeben. Unter Reproduzierbarkeit fallen Kriterien wie Kosten, Material und Arbeitszeit sowie vor allem der Ansatz des Open-Designs – mit der Möglichkeit, gewonnenes Wissen durch die Anfertigung eines Bauplans und einer Materialliste der Öffentlichkeit zur Verfügung zu stellen. Die genannten Faktoren können ein Modell mit vorgefertigten Drucksensoren nicht rechtfertigen. Vor allem wollte sich der Autor nicht auf Vertriebsquellen Dritter (Lieferbarkeit und Verfügbarkeit von Sensoren) verlassen und startete nach Abschluss der Entwicklungsphase von P1 den Versuch, die gewünschte Messtechnik in Eigenproduktion/ eigenständig zu entwickeln. Für den weiteren Verlauf der Prototypentwicklung entschied sich der Autor, andere Varianten der Berührungsmessung zu verfolgen (img_preAKp1.2&3).

Die Gründe für die Fortsetzung der Prototypenentwicklung und für die (Weiter-)Entwicklung der Sensortechnik sind, dass die handelsüblichen Sensoren nicht ausreichend an die Bedürfnisse der Anwendung angepasst werden konnten. Der Autor vertritt die Meinung, dass der Markt zwar eine Reihe von unterschiedlichen Sensoren anbietet und darüber hinaus die entsprechende Peripherie und Schnittstelle zur Verfügung stellt; eine Eigenentwicklung ist aber dennoch zu rechtfertigen, wenn Projektziele wie Aufbau (effizient), Einsatzfähigkeit (flexibel) und Kosten (niedrig) mit einbezogen werden.

P1 ist ein unabhängig arbeitender, autarker Prototyp, der unbemerkt Daten der Berührung

messen und einlesen sowie auf einer Micro SD-Karte speichern kann. Das Testmodell ist drahtlos und kann ohne Stromversorgung eingesetzt werden, es kann Messwerte solange speichern, bis die Batterieleistung (Lithium Backpack 5V) aufgebraucht ist (Die Lebensdauer wurde noch nicht getestet.).

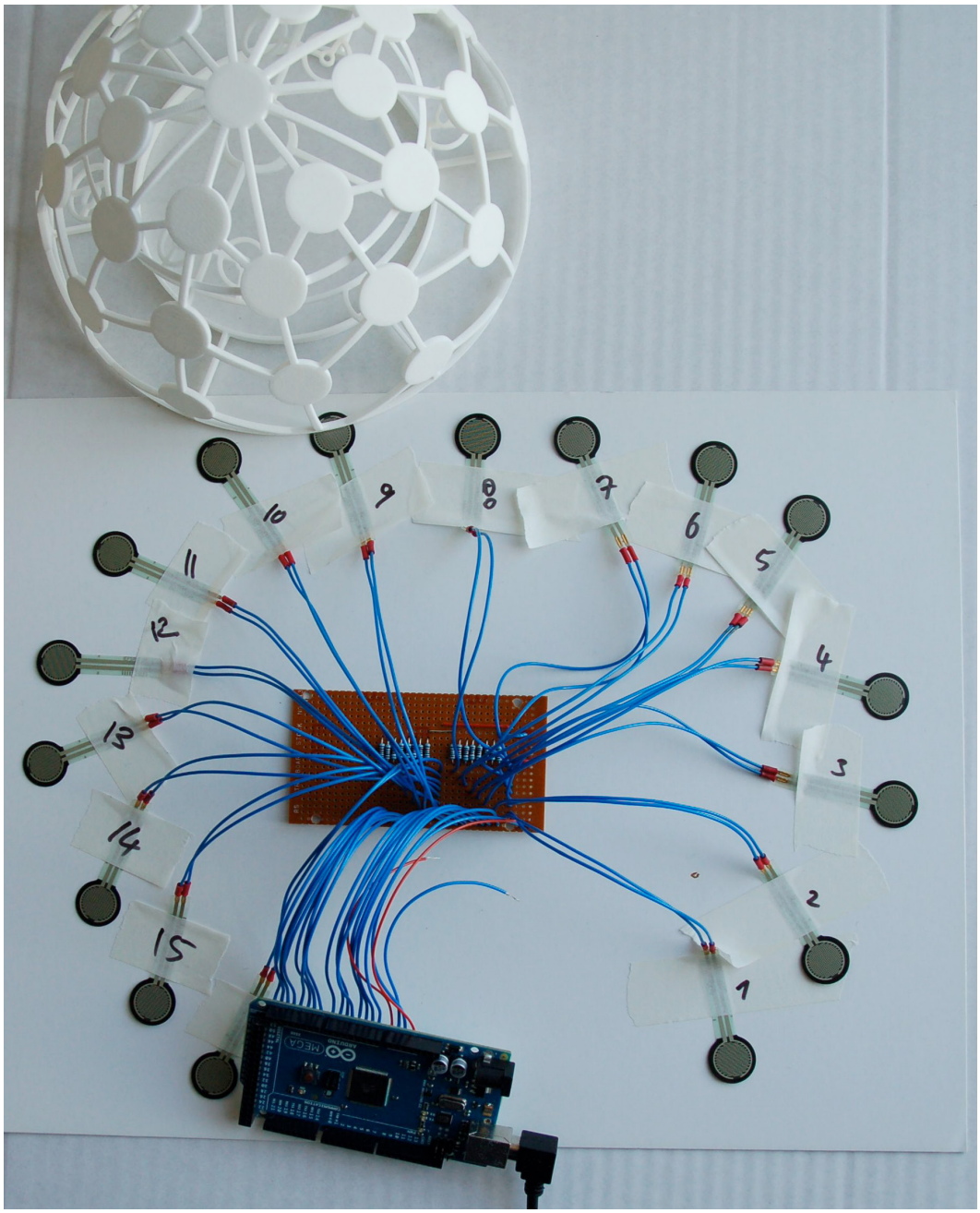


Fig. 5.4 Aufreihung der 16 (32) FSRs in Vorbereitung auf Montage

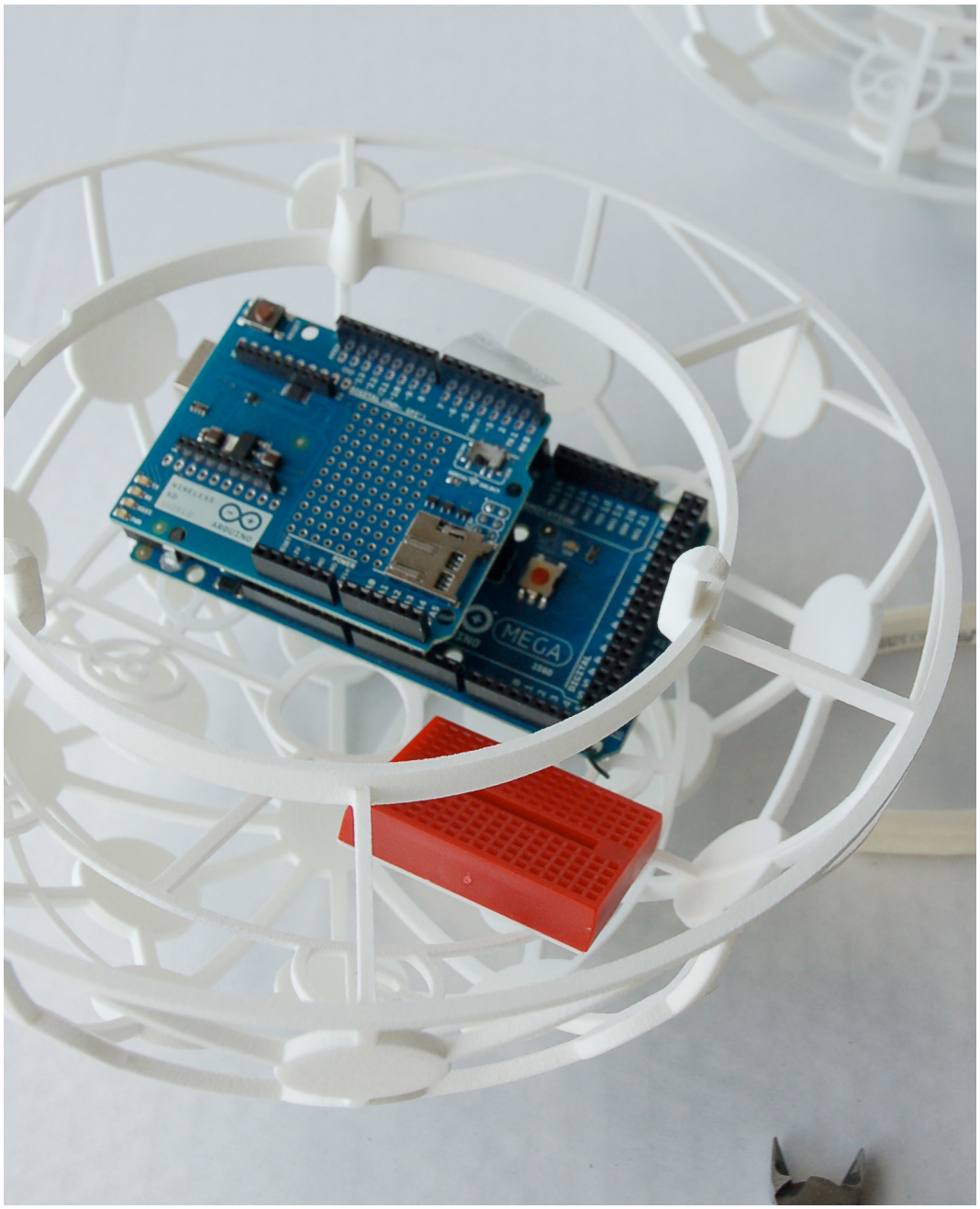


Fig. 5.5 Platzbedarf im Inneren und Montage von P1

Fig. 5.6 P1 mit 200 mm Durchmesser und 32 FSRs

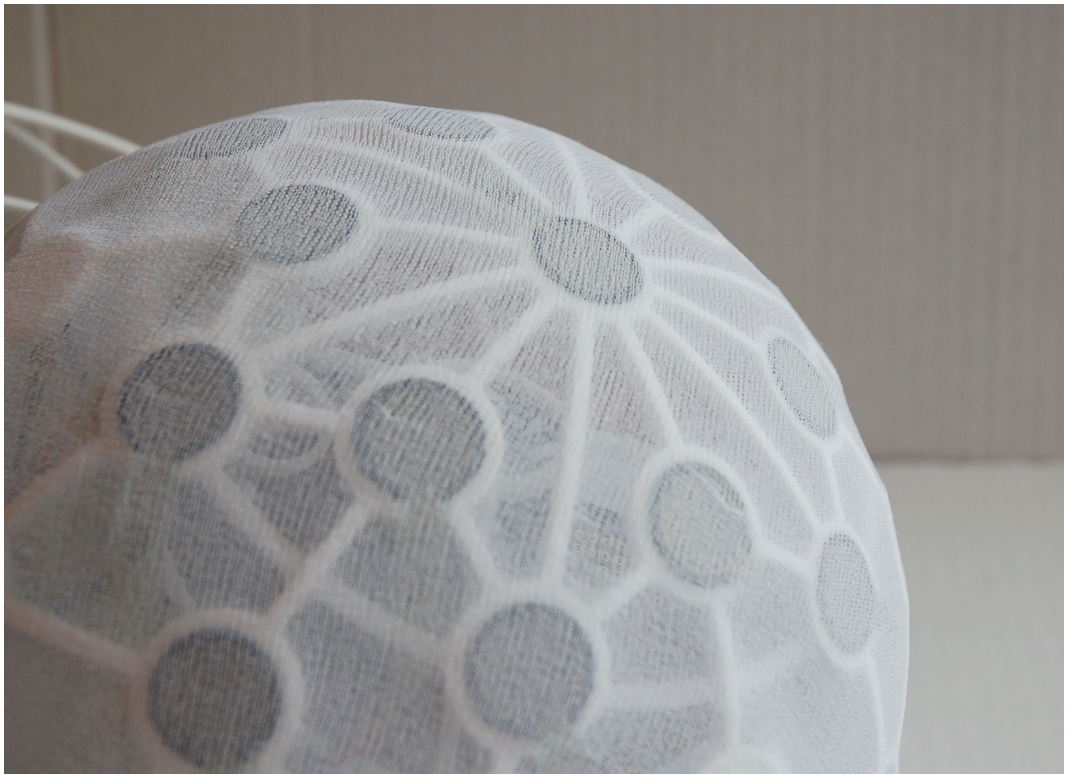


Fig. 5.7 Haptik bei P1

Der Autor kam (nach Test und Anwendung des P1) zu folgenden Erkenntnissen:

1. Daten (Berührungskarte – Mapping) über Positionen der Berührung über einen festgelegten Zeitraum sind bedeutender als präzise Daten zum Auflagedruck (applied force)

2. Tangentiale Distanzen (räumlich) zwischen den Sensoren bilden ungünstige Zwischenräume, sogenannte Blind Spots, die ein Ablesen (und damit Aussagen) über die Handhabung erschweren oder unter Umständen unmöglich machen.

3. Die Anwendung mit Probanden sollte sich an einem klaren Ziel orientieren, am besten gibt man den Anwendern eine zielgerichtete, handhabungs-fokussierte, intuitive und zeitlich begrenzte, kurze, überschaubare Aufgabe.

4. Technische Komponenten sollten verdeckt sein, da das Objekt ein serienreifes Produkt verkörpern soll, anstatt sich dem Anwender als halbfertiges Rohmodell zu präsentieren. Gleichzeitig sollte es jedoch für Wartungszwecke leicht zugänglich sein. Die aus der Sichtbarkeit der Messtechnik resultierende Schwierigkeit besteht darin, dass sie den Verlauf der Handhabung ungünstig verfälschen kann. Zudem soll die Anwendung nicht den Eindruck einer Laboratmosphäre vermitteln, da dies das “normale” Verhalten der Probanden beeinflusst.

5. Das semi-transparente Netzmaterial, das aktuell beide Hälften umspannt, um die Sensortechnik und die dazu gehörenden Komponenten zu kaschieren und dem Anwender eine haptisch angenehme Tastfläche zu bieten, ist zu durchsichtig. Dies hat zur Folge, dass den Probanden der Einblick gewährt wird, was wiederum unbeabsichtigt ist und einen undefinierbaren Einfluss auf die Art und Weise der Handhabungen hat.

5.6.2 P1 Fazit

Welche Hauptziele wurden mit der Entwicklung des P1 auf Basis des “7-Punkte-Plans” (Stand 18.10.2012) erreicht und welche Punkte des Fragenkatalogs konnten beantwortet werden? Im Sinne der Forschungsfragen, mit dem Ziel der

1) Identifizierung/Feststellung von unterschiedlichen Körpergrößen und

2) Ablesbarkeit von wechselnden Handhabungsmustern durch Einbeziehung verschiedener Probanden, die mit der Entwicklung des berührungssensitiven Modells adressiert werden sollten, können die durch P1 ermittelten Messwerte keine eindeutige Aussagen liefern/leisten.

Gründe dafür liegen darin, dass aktive Berührungen in Bereichen auftauchen können, die nicht von Sensoren abgedeckt sind, und somit nicht registriert werden und somit durch das Raster fallen. Die Erkenntnis, dass besonders subtile, sanfte und kurzzeitige, kleinflächige Berührungen für die Aussage über unterschiedliche Handhabungsmuster von Bedeutung sind, ist erst im Laufe der Anwendung von P1 erzielt worden. Eine Limitation der Anzahl von 16 FSRs pro Halbkugel, die verknüpft ist mit den (auf) 16 limitierten Steckplätzen der analogen Inputs (und der Leistungsfähigkeit) des gewählten Microcontrollers, projeziert auf eine Halbkugel mit dem Durchmesser 200 mm, ergibt eine ungünstige Konfiguration aus blind spots zwischen einzelner Sensoren und Freiflächen, die nicht vernetzt sind. Abhilfe könnte man schaffen, indem man durch Verkleinerung des Durchmessers die Oberfläche des Körpers minimiert oder die Anzahl der Sensoren erheblich (Faktor 3) erhöhen würde. Der Autor entschied sich gegen den Einsatz handelsüblicher Sensoren und zog erstmals die Entwicklung eigener Sensoren in Erwägung.

Entwicklung, Montage und Bau von P1 lieferte dem Autor wichtige Erkenntnisse über die Gestaltung von berührungssensitiven Objekten und erste Einblicke in den Umgang mit Elektronik und in ein Zusammenwirken von Schnittstellen zwischen Hardware und Software. Eine (derart gut informierte) Fortsetzung der Entwicklung von physikalischen Modellen zur Ermittlung taktiler Daten und die Herstellung erweiterter Prototypen hätte ohne die anfänglichen Erfahrungen aus der ersten Phase der Testmodellentwicklung nicht vollzogen werden können. Die Erkenntnisse aus der Entwicklung von P1 informierten den Autor darüber, dass die gestaltete Oberfläche aus einzeln platzierten Drucksensoren die Daten liefern, aber für ein ausreichendes Verständnis von diversen Handhabungsmustern ungenügend sind.

5.7 Prototyp 2 (Vert)

5.7.1 P2 Beschreibung

Die Entwicklung von P2 beruht auf den Erkenntnissen aus der Entwicklungsarbeit von P1. Warum wurden handelsübliche FSRs ersetzt durch eine Matrix aus conductive threads? Der Autor entschied sich für das Vorhaben, eine maßgeschneiderte Sensormatte eigenständig zu entwickeln, die den Aufbau eines FSR-Matrix nachbildet, Funktionsweisen verbessert und die Bauweise vereinfacht. Die Erkenntnisse aus Entwicklung und Anwendung mit P1 informierten den Autor darüber, dass der Schwerpunkt der Berührungsmessung – hinsichtlich der Beantwortung der Forschungsfragen der Generierung informativer, prüfbarer (und reproduzierbarer) Berührungsdaten – weniger auf einer Präzision der Druckstärke sondern auf der Umverteilung zeitgleicher Berührungsbereiche liegen sollte. Der Autor kam zu der Schlussfolgerung, dass das Vorhaben nur durch die Entwicklung einer speziellen Sensormatte erreicht werden kann. Der Autor realisierte, dass handelsübliche Sensoren die Aufgabe nicht erfüllen würden und entschloss sich an dieser Stelle der praktischen Arbeit, Zeit in die Eigenentwicklung zu investieren.

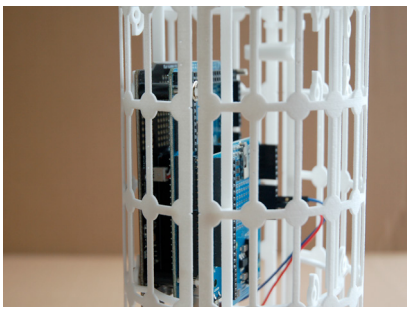


Fig. 5.8 Platzberdarf und Montage für Arduino Mega in P2

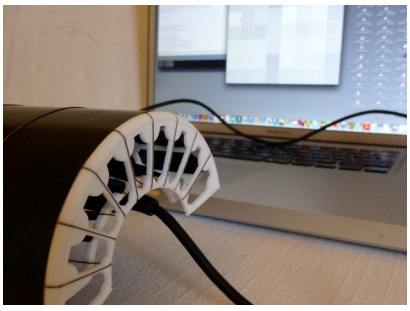


Fig. 5.9 Austritt des Kabels

Fig. 5.10 Gummiverspannung für die 8 vertikalen Spalten

Für die Fortsetzung der praktischen Forschungsphase innerhalb der Systematik des Vorhabens, entschied sich der Autor für die Notwendigkeit, einen Körper (Testmodell) mit folgenden zusätzlichen Eigenschaften und Leistungen zu entwickeln. Es soll ein zweites, in der Entwicklung verfeinertes Testmodell gestaltet und gebaut werden, das

8) einen niederkomplexen Aufbau für die Berührungsmessungen verwendet

9) möglichst wenig vorgefertigte Komponenten zum Messen verwendet (Vermeidung

von Kosten, Verfügbarkeit, Wartezeiten d. Lieferung)

10) einen flexiblen Einsatz der Messsensorik sowie eine Anpassungsfähigkeit und

Feinjustierung ermöglicht (Eigenproduktion ermöglicht eine Justierung der

Messfunktionen im Detail)

11) die Option bietet, die Sensibilität der Fläche in der Dichtheit den

Umständen, Erwartungen und Zielen der Anwendung anzupassen

12) eine einfache Zugänglichkeit zu Wartungszwecken (ähnlich wie beim Aufbau von

P1 die Zweiteiligkeit) zulässt

13) eine solide Standfestigkeit, Ausrichtung und Orientierung besitzt

14) unter den Ansatz des Open-Design (Reproduzierfähigkeit durch dritte Parteien) fällt

Die oben erstellte Liste mit den Zielvorgaben ist mit dem Titel “Plan der erweiterten Testmodellentwicklung (Stand Januar 2013)” versehen und gilt als Fortsetzung/ Weiterführung des “7-Punkte-Plan der Testmodellentwicklung” (Stand 18.10.2012)”, die weiterhin als Ausgangspunkt gültig ist. Es ist eine dreidimensionale, drucksensitive Flächenstruktur zu entwickeln, mit niederkomplexem Aufbau, aber flexibel im Einsatz, kostengünstig und mit handelsüblichen Komponenten hergestellt, die zudem reproduzierbar ist.

Fig. 5.11 Aufnahmedetail für Fadenmontage bei P2

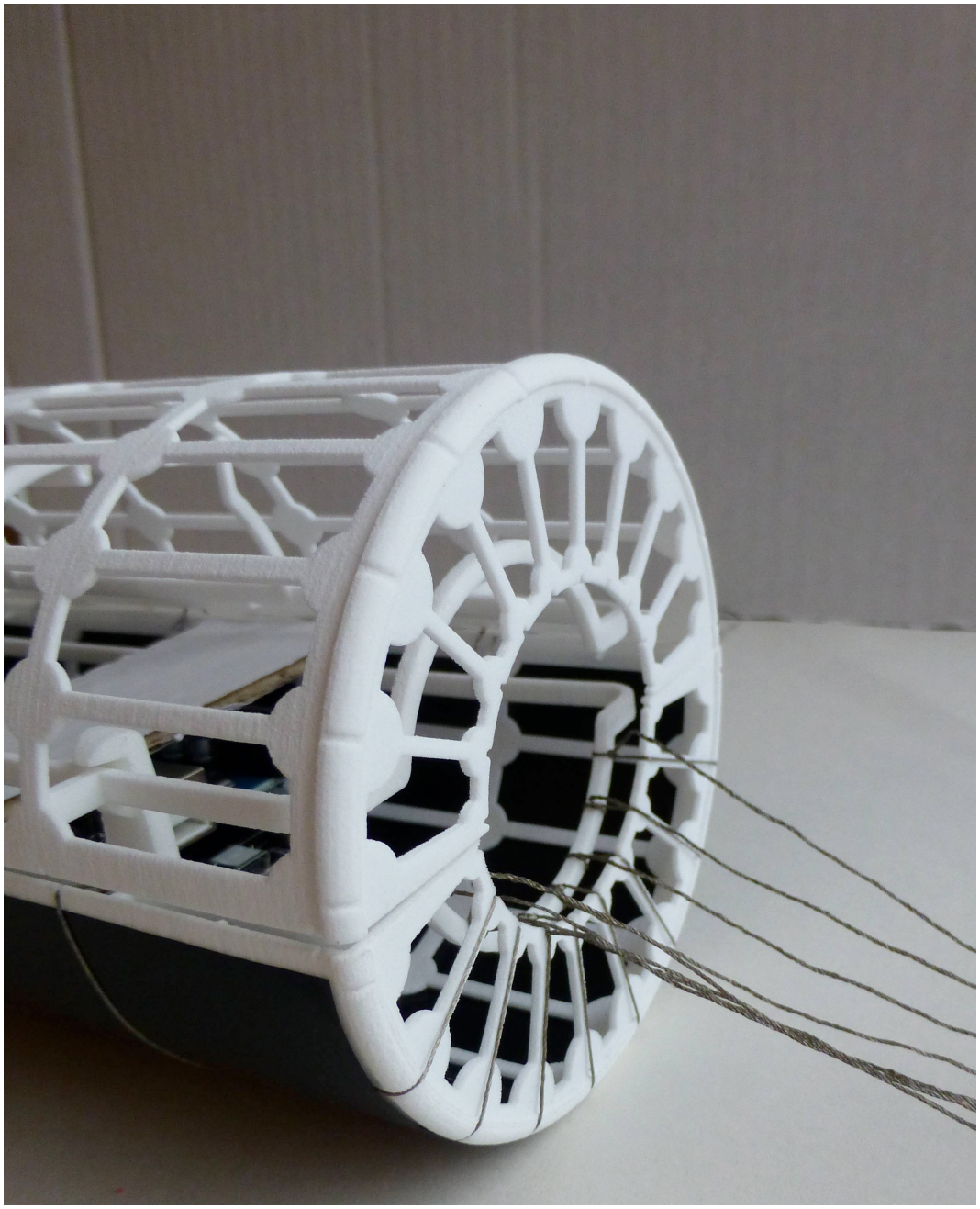


Fig. 5.12 Detail der Fadenverspannung bei P2

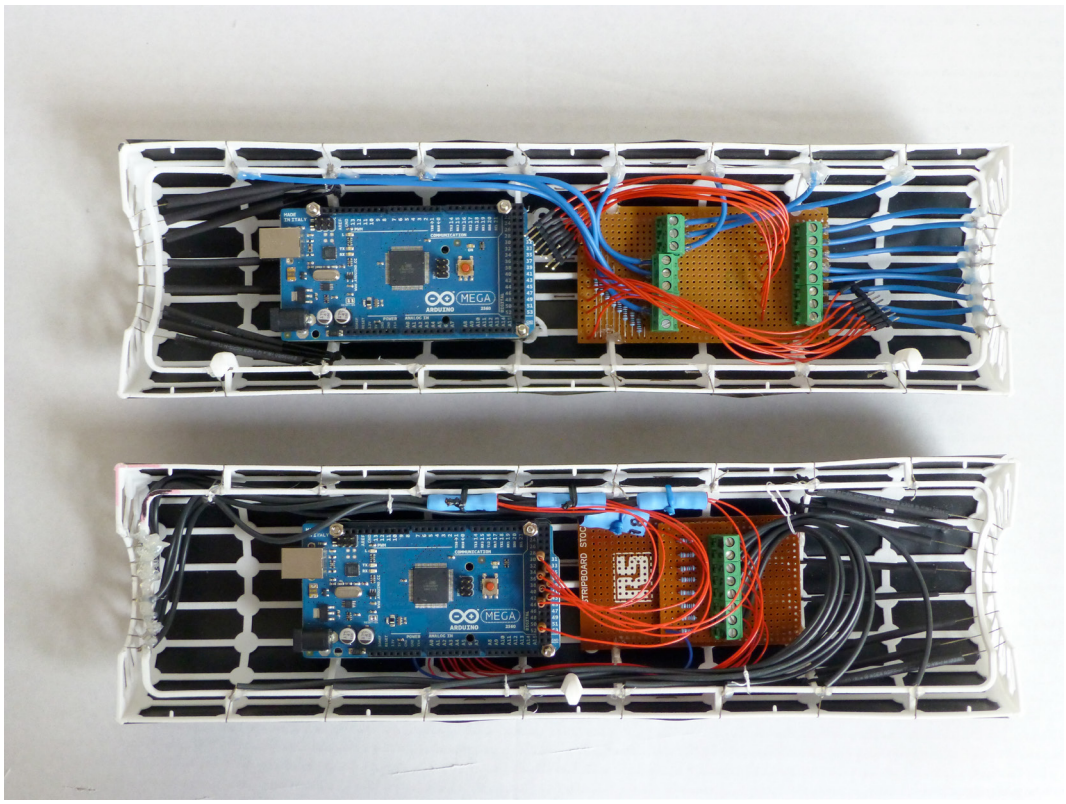


Fig. 5.13 Innenleben von P2 (Arduino Megas)

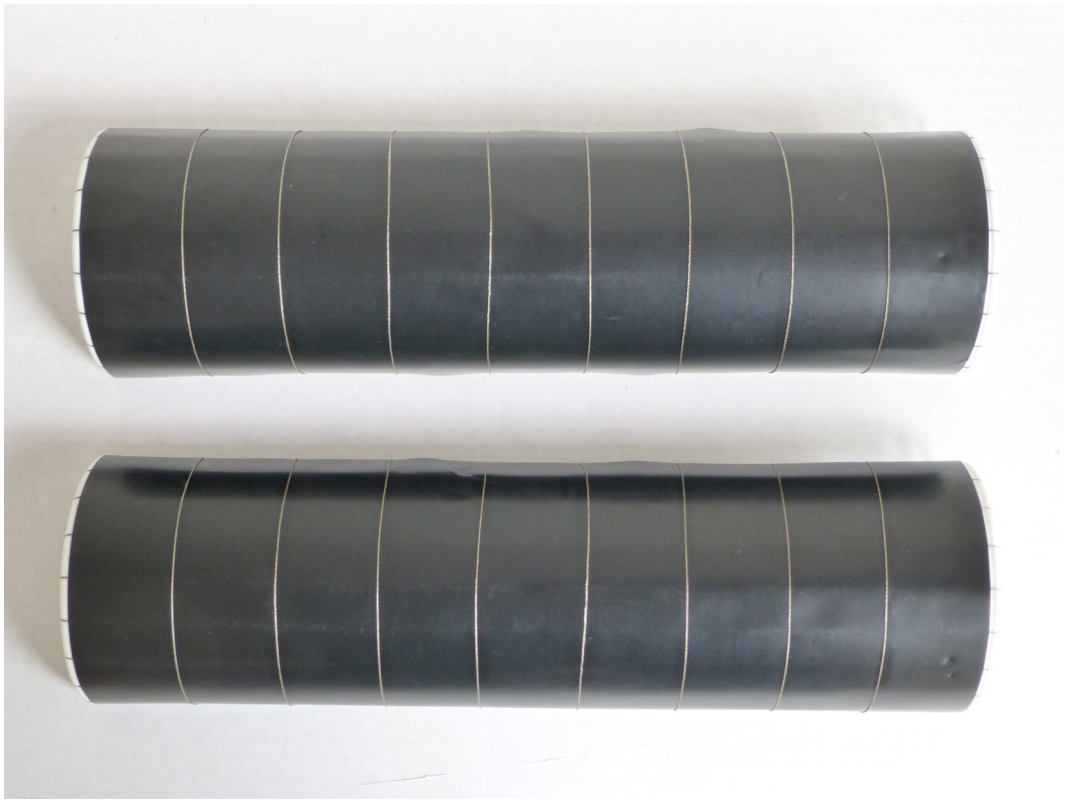


Fig. 5.14 Aussenseite von P2

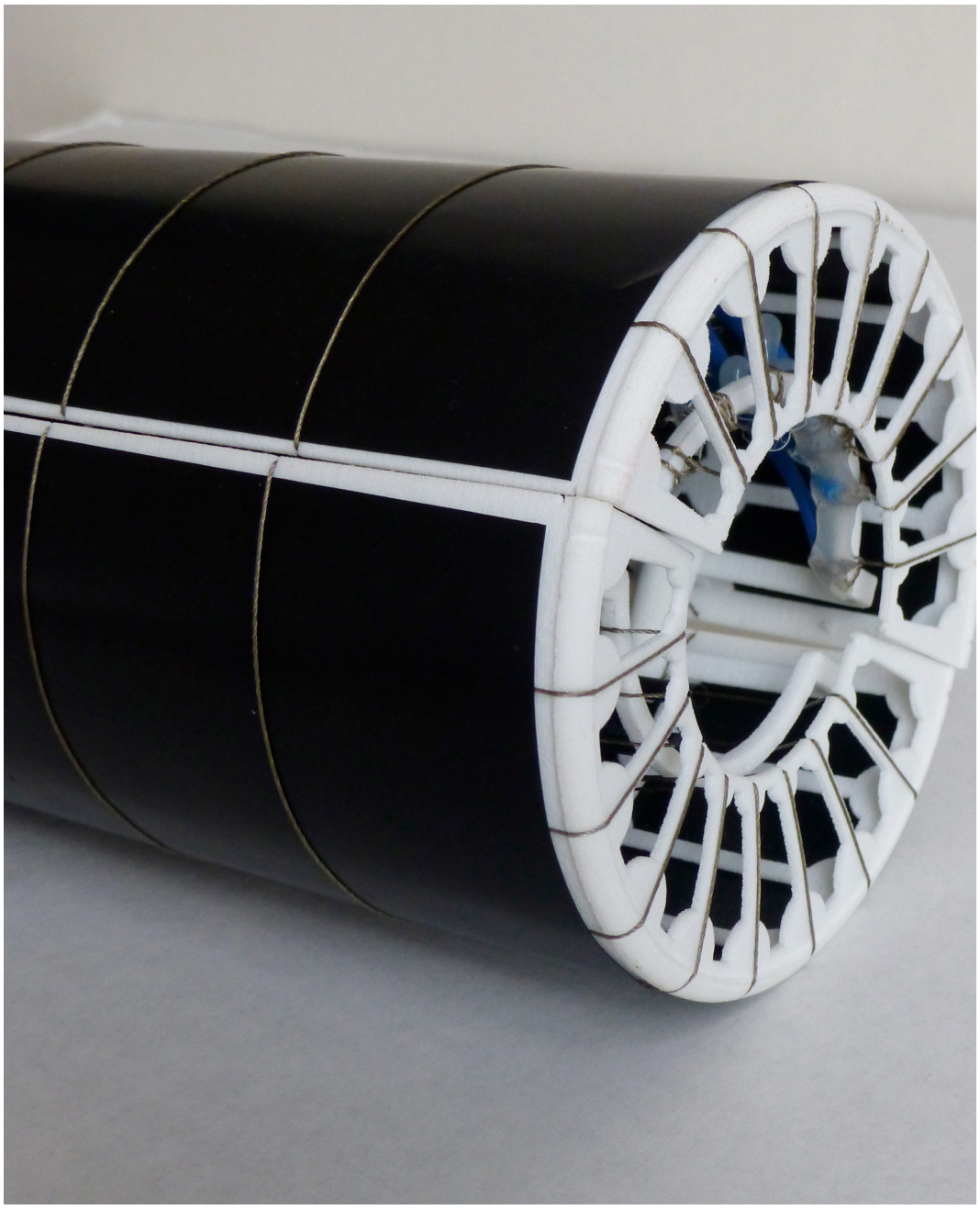


Fig. 5.15 Zweischalige Bauweise und Montage bei P2

Der Autor beabsichtige mit der Entwicklung von P2 in Gegensatz zu P1 eine vertikale Orientierung zu erreichen. Er wählte ein zylindrisches Profil mit dem Durchmesser von 100 mm und einer Gesamthöhe von 350 mm. Die schlichte Form des Körpers soll dem Anwender klar suggieren, welche Fläche des Körpers als Stellfläche und welche zum Anfassen und Berühren vorgesehen ist. Bei dem Design der Trägerstruktur wurde darauf geachtet, dass die Oberflächen ein Maß an Flexibilität bieten, das dem Anwender erlaubt, den Körper leicht einzudrücken ohne auf zuviel Widerstand zu stoßen und dem Anwender zugleich ein Gefühl einer direkten Rückkopplung (feedback) gibt. Das Modell P2 arbeitet kabellos und besitzt die gleiche Stromquelle (Lithium Backpack 5V) wie bei P1. Die Aktivität der Messungen wird durch eine blinkende LED angezeigt. Die Messwerte werden auf einer Micro SD Karte (2GB) als Protokoll gespeichert. Nach Anwendung des P2 erhielt der Forscher erste Visualisierungen der Berührungsdaten, dargestellt durch ein Raster aus 16 Reihen und 16 Kolumnen (8x8 pro Halbzylinder – technisch bedingt), wobei jedes Quadrat mit einer Variation an Grauwerten (0-255) belegt ist. Das Erscheinen eines Grauwertes zeigt die Berührungsaktiviät des jeweiligen sensitiven Bereiches an. Der Wert der Grauverfärbung spiegelt die Druckintensität dynamisch (und in Echtzeit) wider. Der Autor erhält mit dem P2 eine zweidimensionale, dynamische (animierte) Berührungskarte (sensing map) mit einem Raster von 16x16 auf den zylindrischen Körper verteilt. Die Berührungskarten sind keine Simulation mehr, sondern Karten mit einem Höhenprofil auf Basis der Druckintensitäten der jeweiligen Berührung.

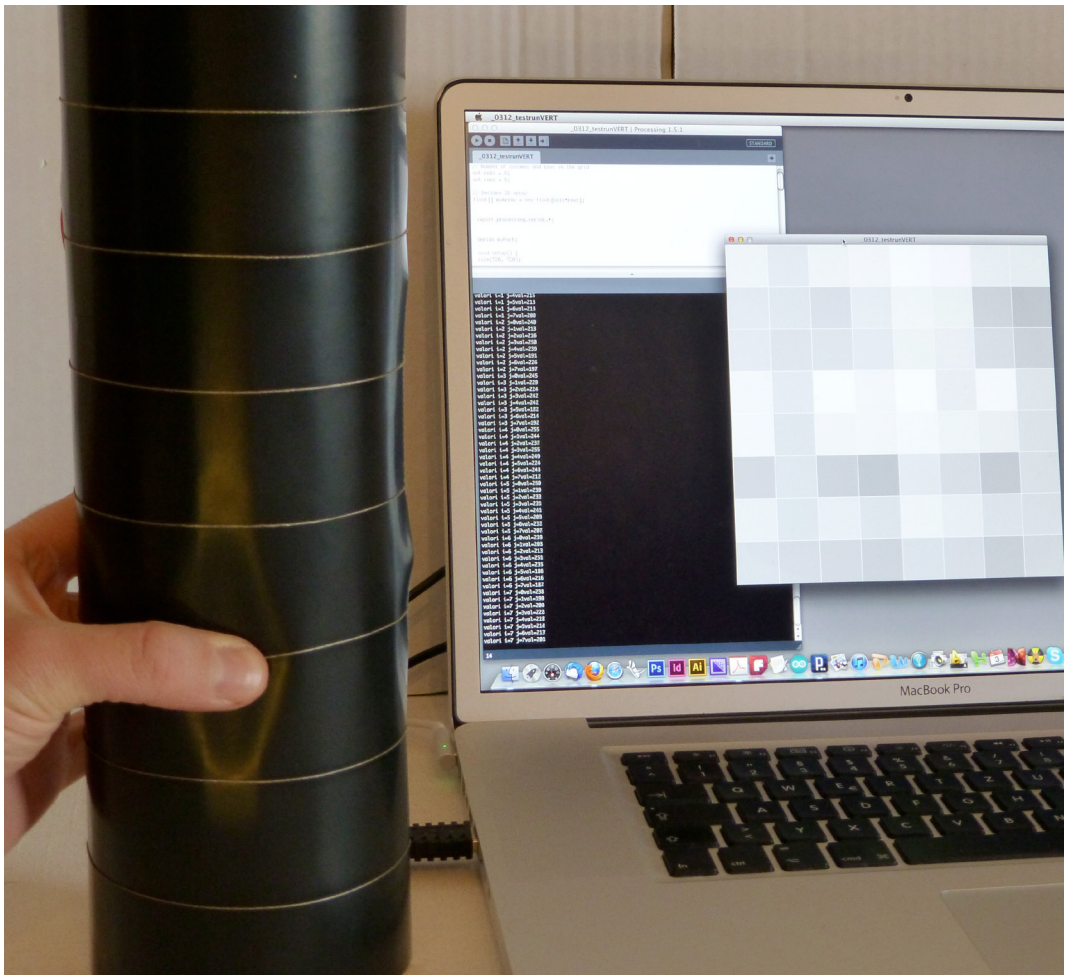


Fig. 5.16 Vertikale Ausrichtung bei P2 und Beweis der Messfunktion (8x8 Matrix)

5.7.2 P2 Fazit

Der Autor kann nun (im Vorfeld der Weiterentwicklung fortgeschrittener Prototypen) die Daten sprechen lassen und diskutieren, ob 1) die generierten Berührungsbilder für sich, allein verständlich sind, 2) zu welchen Inhalten die Karten führen und 3) welche Aussagen über die Handhabungsmuster getroffen und letzlich 4) welche Aussagen über deren Verteilung und Zuordung zu Personengruppen vorgenommen werden können. Folgende Ergebnisse konnte der Test von P2 erzielen. Die Anwendung ergab, dass das Testmodell P2 zusammen mit der Hardware (CPU) stabil und wiederholt in der Lage ist,

1) Werte von leichten, subtilen und sanften Berührungen zu messen. Ein sachtes

Antippen eines Bereiches wird vom System registriert, wenn die Position eine

Kreuzung der Gitterstruktur trifft.

2) eine relativ große Berührungsfläche – gemessen an der Ausgangsfläche - (in

Echtzeit ohne Verzögerung) als zusammenhängende Kontaktfläche zu registrieren.

D.h. Ein Umfassungsgriff ist ohne Zeitverzögerung (delay) sichtbar.

3) Daten von Berührungen auf jeweils zwei Flächen von jeweils 350 mm x D 100

mm (gleichzeitig mit 2 Microcontrollern mit jeweils 8 analogen Inputs) zu lesen

(Abwicklung berechnen und Projektion zeigen)

4) Daten dynamisch als Arrays darzustellen.

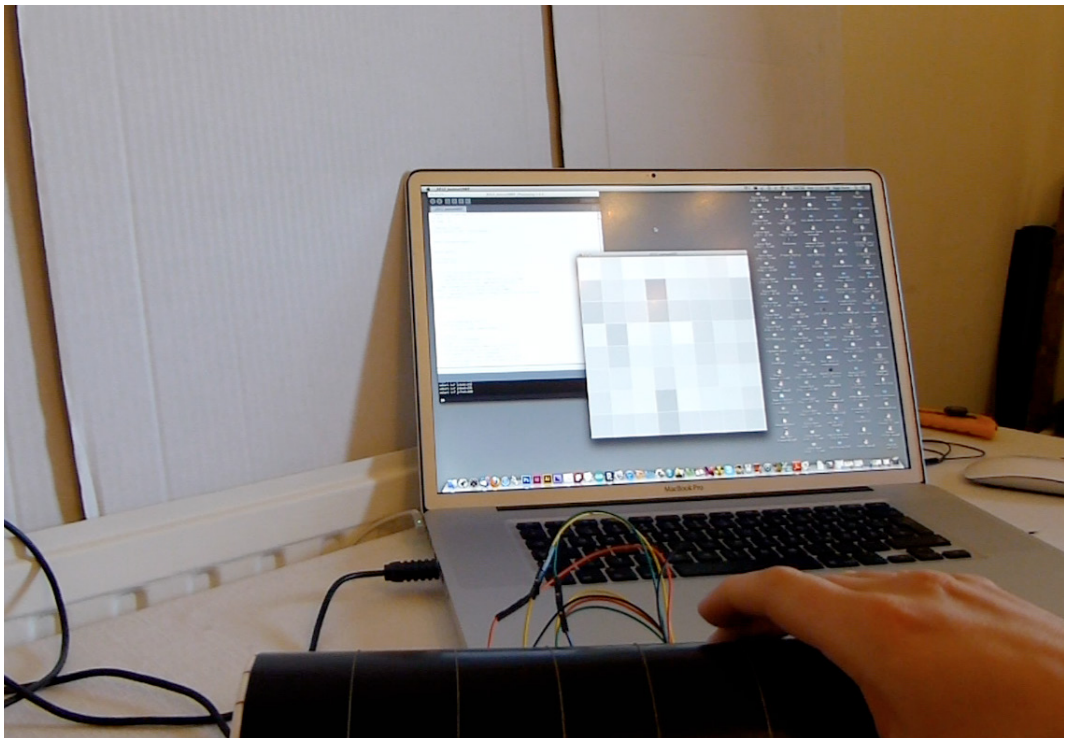


Fig. 5.17 Beweise der Drucksensivität mit P2

Bei genauerer Auswertung und Betrachtung der Daten konnte der Autor zeitweise zufällig auftretende Lesefehler beobachten. Der Autor unternahm am Ende der Phase P2 den Versuch, die Fehlerquellen zu lokalisieren oder zumindest Mutmaßungen über deren Aufkommen anzustellen. Nach damaligem Erkenntnis-/Wissensstand (Oktober 2012 bis dato) kann der Autor die Ursachen der Fehler nicht exakt bestimmen und auch nicht belegen, ob diese in dieser Entwicklungsphase für den Erkenntnisgewinn ein Hindernis darstellen. Auch sieht sich der Autor nicht in der Lage, aufgrund der vorliegenden Information mit Sicherheit zu sagen, ob die Fehler in den Messungen vorkommen oder ob diese nicht lediglich Darstellungsfehler der Visualisierung durch das Processing sind. Grund dafür ist der Umstand, dass die Datenanimationen nicht parallel als Messwerte vorliegen. Da die Testeinheit P2 lediglich Arrays aufgezeichnet hat und keine weitere Aufzeichnung der Messwerte (print data) parallel oder synchron getätigt wurde, kann der Autor keinen Abgleich der Datenformate vornehmen, um nach Fehlerquellen zu suchen. Die Tatsache, dass es für die Analyse der Messungen ausschlaggebend ist, die Daten sowohl als Messwerte als auch im Format einer Darstellung (arrays) zu speichern, wird bei dem weiteren Prototypenbau Berücksichtigung finden müssen.

Der Autor stellt folgende Vermutungen über Ursachen einer Abweichung der Messwerte an. Mögliche Ursachen:

Die Zugspannung des leitfähigen Garns (Reihen/Spalten) ist unterschiedlich und

deshalb sind die Lesungen der Spannung abweichend

Die Struktur der Tragekörper ist zu flexibel, dadurch werden bei Druck auf bestimmte

Bereiche andere Bereiche räumlich verändert. Dies ist insbesondere eine Erkenntnis,

die bei der Anwendung von Prototyp 2 Vert (8x8) erzielt wurde.

Leitfähige Garne berühren sich (intern oder extern)

Verbindungen haben sich gelöst: zwischen Garn und Hard Wiring oder zwischen hard

wiring und Printed circuit board (Pcb)

Distanzen zwischen Reihen und Spalten sind unterschiedlich und verändern sich bei

Berührungsdruck durch den Anwender

Isolierung funktioniert nicht

Code ist falsch geschrieben oder hat Fehler

Entwicklungsaufgaben für P3

Lesefehler und Verzögerung erläutern und Möglichkeiten der Abhilfe beschreiben. Wie können die technischen Probleme gelöst werden? Derzeitiger Stand der technischen Entwicklung reicht nicht aus, um Forschungsfrage zu diskutieren und zu beantworten. Welche Änderungen und Verbesserungen müssen vorgenommen werden, um ein Ablesen prüfbarer Daten – mit geringerem Toleranzbereich – möglich zu machen? Wie kann der Autor in der geplanten Zeit die Ursachen und Fehlerquellen lokalisieren und die Ursachen beheben? Eine Frage der Kompetenz.

5.8 Prototyp 3 (Sensing Pot)

5.8.1 P3 Beschreibung

Die Entwicklung von P3 beruht auf Erkenntnissen der praktischen Entwicklungsarbeit von P1 sowi P2. Der Übergang von P2, der lediglich als Technikträger entwickelt und eingesetzt wurde, zu P3 ist ein wichtiger Schritt der Erkenntnisgewinnung über die Bedeutung und Machbarkeit der Forschungspraxis. Der Ansatz einer Bestimmung der Ermittlung prüfbarer Daten soll mit der Entwicklung eines finalen Prototypes zum Erfolg kommen. Der Phase 3 liegen folgende Zielsetzungen zu Grunde. Der Prototyp soll neben seiner Messfunktion eine weitere, praktische Funktion erfüllen, auf die verschiedene Anwender ergebnisorientiert hinarbeiten sollen. Diese Erweiterung des Nutzens (d. Prototyps) erfordert eine technische und gestalterische Überarbeitung.

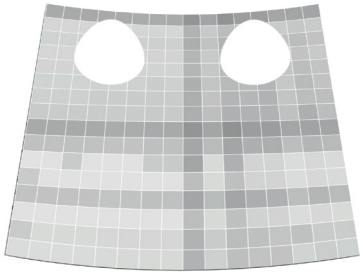


Fig. 5.18 Abwicklung mit 16x16 Matrix

Fig. 5.19 Matrix (32x32) am Objekt

Die Stabilität des Baukörpers und der erweiterte Platzbedarf für eine verbesserte Technik stellen besondere Herausforderungen dar.

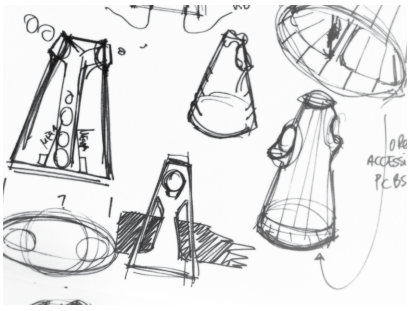


Fig. 5.20 Skizze

Der Autor sieht in Phase 3 der Prototypenentwicklung vor, die Anzahl der drucksensitiven Bereiche zu erhöhen mit dem Ziel, die Aussagen über die Handhabung deutlicher zu machen. Generell gilt es in der finalen Phase der Testmodellgestaltung, Ablesevorrichtungen zur Messung der Berührungen zu verfeinern, Fehlerquellen in den Messvorgängen zu minimieren und eine Anwendung mit externen, neutralen Probanden durchzuführen.

Dimensionen, Form und Funktion des P3 – Ergonomie

Bei der Gestaltung (P3) wurden die Dimensionen entsprechend der zu erwartenden Probanden und deren ergonomischer Anforderungen in die Entscheidung einbezogen. Der Autor plant Probanden unterschiedlichen Alters (Kinder, Erwachsene – 5./50./95. Perzentil) in die Testreihen (1) einzubeziehen. Dies ist erforderlich, um möglichst unterschiedliche Bewegungsmuster herbeizuführen und in Vergleich zu setzen. Es gilt nun, in der Praxis zu verstehen, ob das entwickelte Messsystem in der Lage ist, die zentrale Frage über die Aussagekraft auf Basis der Daten zu beantworten.

Erweiterte Forschungsfragen

Wie kann die Feinheit der Berührungssensorik (geplant in P3) das Verständins über die Handhabung beeinflussen? Kann der Autor auf Basis der Erkenntnisse aus der Entwicklung und per Analyse der Daten aus P1/2 mit Bestimmtheit sagen, dass für die Entwicklung der Matrix der Faktor gilt: Je dichter ergo feinmaschiger die Matrix, desto feiner die Ablesungen und desto besser und eindeutiger die Aussage über die Handhabung?

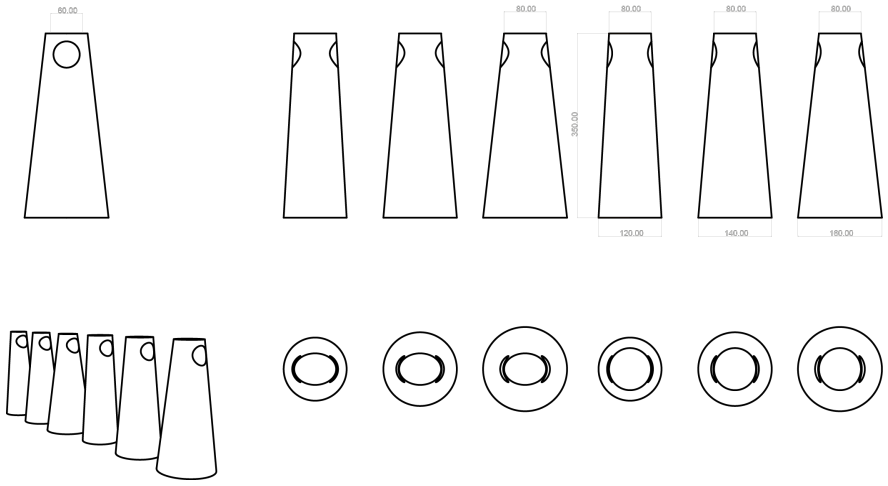


Fig. 5.21 Formentwicklung

Faktoren der Berührungsmessung

Welche Faktoren sind ausschlaggebend für das Verstehen der Handhabungsmuster mit den entwickelten Prototypen? Wie kann der Autor auf Basis der Datenvisualisierung mit Arrays Gebrauchsvorgänge verstehen und welche Kriterien können daraus (für zukünftige Anwenderszenarien) gebildet werden? Folgende Vorkommnisse wurden aus der Entwicklung des P3 im Vorfeld zur Anwendung im User Testing (Dezember 2012) beobachtet (hier fehlt eine Aufzählung der Beobachtungen!). Aus den Erkenntnissen der Beobachtungen konnte der Autor folgende Kriterien ableiten, die als Grundlage für die o.g. User Testing Session dienen sollen.

Fig. 5.22 Velostat-Jacke im Entwurf; 32 vertikale Spalten aus leitfähigem Garn montiert

Fig. 5.23 Verschiedene haptische Wahrnehmungen durch unterschiedliche Oberfächen beeinflussen den Umgang mit dem Objekt

Folgende Kriterien sollen berücksichtigt werden, bzw. dafür sollen Daten ermittelt werden.

1) Kann das geplante Nutzer/Anwendungszenario folgende Faktoren messbar machen?

Faktoren der Berührungsanalyse:

Position Berührungen

Kraft (auferlegter Druck)

Wiederholung der Berührungen (Muster)

Pausen (keine Berührungen) unerwartete Bewegungen des Messkörpers

(Körper fällt um)

Körper wird mit einem Gegenstand berührt

Orientierung des Modellkörpers: Drehen des Modellkörpers um die vertikale, horizontale und körpereigene Achse

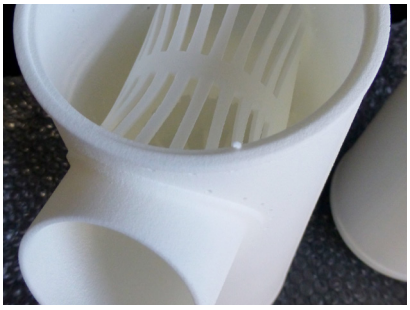


Fig. 5.24 RP-Modell

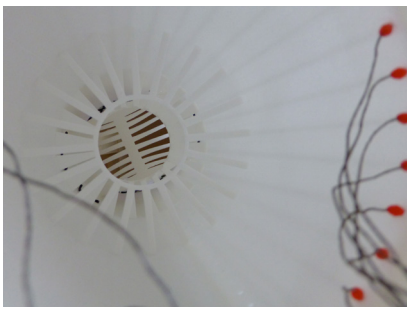


Fig. 5.25 Blick in Hohlraum

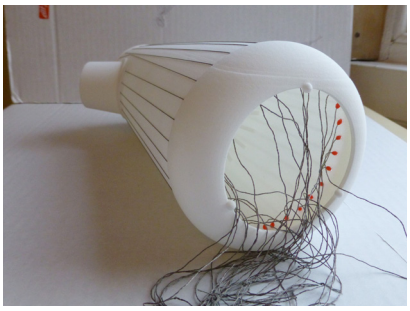


Fig. 5.26 32 Vertikale Verspannungen

2) Kann das o.g. Konzept der Verfeinerung der Sensormatrix die unten genannten erweiterten Faktoren erfüllen?

Erweiterte Faktoren der Berührungsanalyse:

volles Verständnis über Handhabungsmuster (unabhängig und ohne Überprüfung

durch andere Methoden) liefern

Unterscheidung in Körpergrößen

Schwierigkeiten in der Handhabung (Abbruch der Anwendung) erkennbar

Unterscheidung in körperliche Einschränkungen

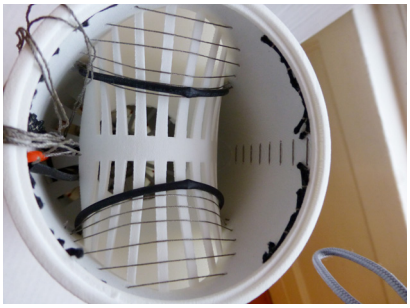


Fig. 5.27 Einblick von oben in P3

Fig. 5.28 Technik zur Fadenspannung durch Silikonstopper (Entwurf des Autors)

Fig. 5.29 Kabelmontage (32x32 Matrix)

Fig. 5.30 Kabelmanagement im inneren von P3

Bei der Gestaltung (von P3) wurde das Ziel verfolgt, ein Objekt herzustellen, das als reales Produkt wahrgenommen wird und weniger den Charakter eines Testmodells besitzt. Es ist demzufolge wichtig, dem Objekt eine primäre Funktion zuzuordnen, die für den Anwender sinnvoll und nachvollziehbar erscheint. Der Zweck Modell P1 und P2 – als Technikträger – lag lediglich darin, Berührungen vom Anfassen und Anheben der Körper zu messen, was der Autor als sekundäre Funktion bezeichnet. Auch in puncto Material, (Gehäuse)-Design und Gewicht soll das Objekt die Eigenschaften eines realen Produkts widerspiegeln. Bei dem geplanten Konzept einer (Heiß)-Wasserzubereitung soll simuliert werden, dass das Objekt beim Befüllen an Gewicht zu,- und beim Entleeren abnimmt. Der Autor entschloss sich dabei, das Element Wasser – aus Gründen der technischen Umsetzbarkeit der Anwendung – durch feste Partikel zu ersetzen. Letztendlich fiel die Entscheidung auf die Verwendung von handelsüblichen Ping-Pong-Bällen, die den Fluss von Wasser simulieren sollen.

Fig. 5.31 32 Horizontale Reihen aus leitfähigem Garn, montiert

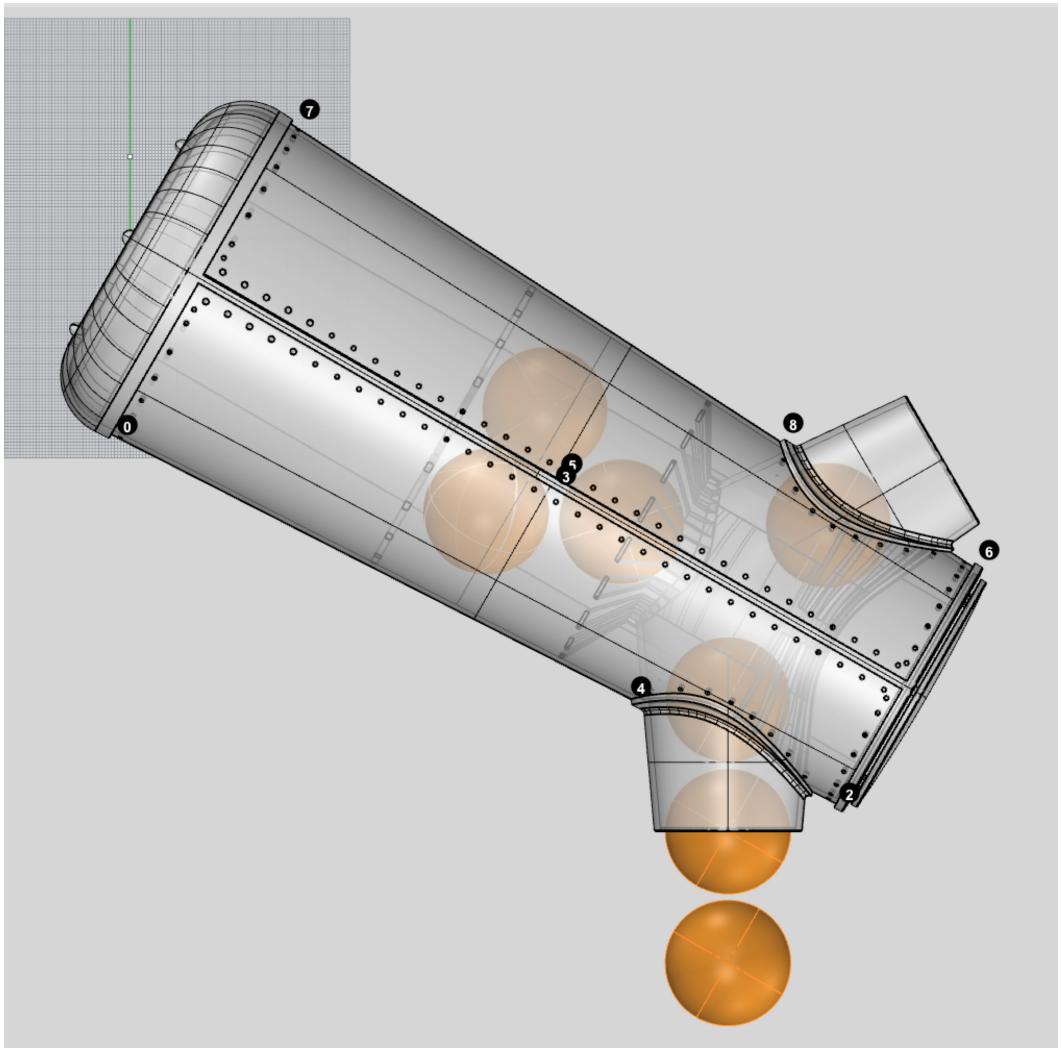


Fig. 5.32 Wassersimulation durch Ping-Pongbälle (Kapazität sechs Stück) mit zwei Tüllen (ergo zwei Möglichkeiten zur Befüllung bzw. Entleerung)

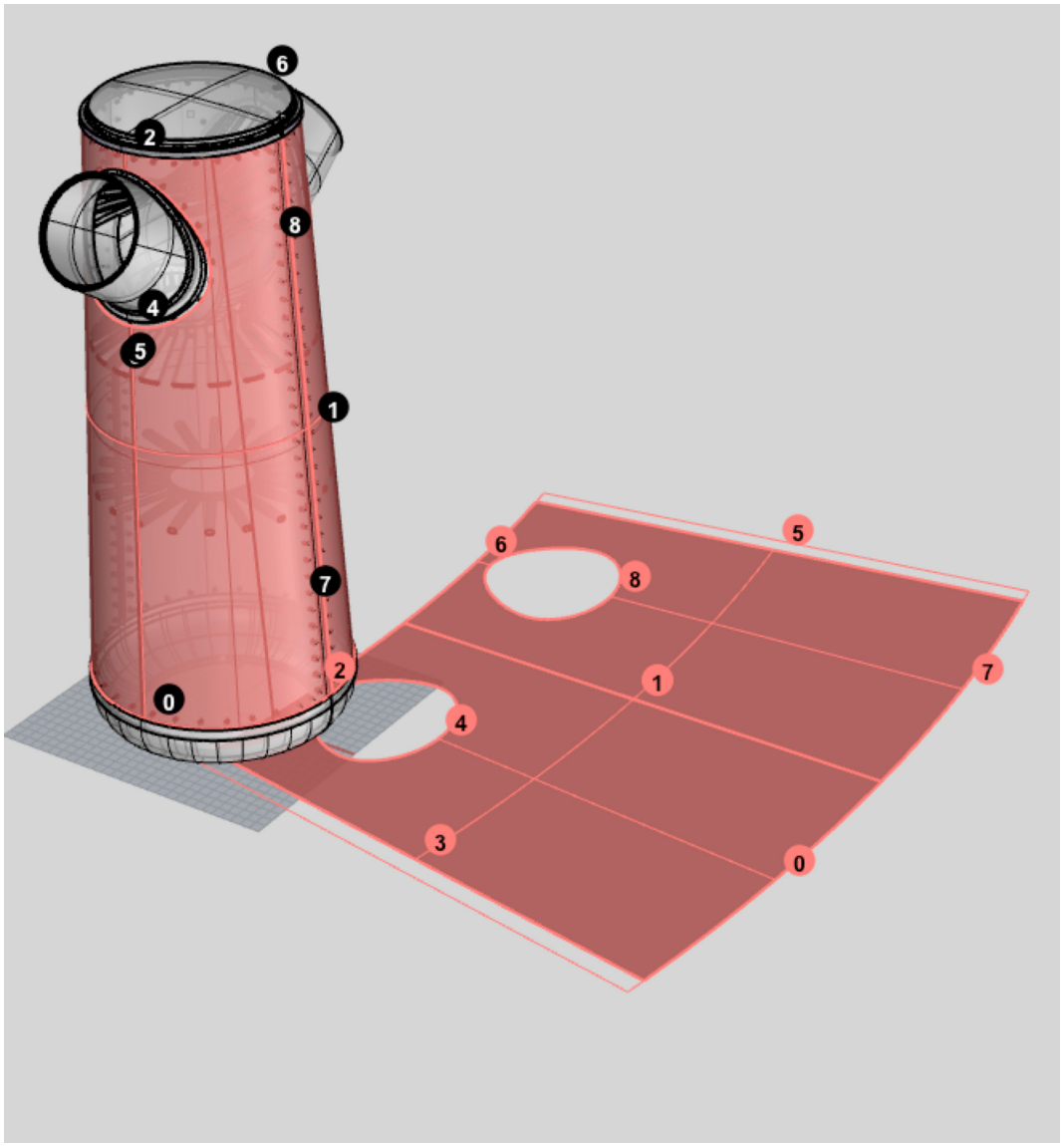


Fig. 5.33 Abwicklung (Projektion) des Velostat-Mantels bei P3

Das Objekt besitzt im Inneren ausreichend Freiraum, so dass eine definierte Anzahl von Ping-Pong Bällen (maximal 6 Stück) aufgenommen werden kann. Ein einfaches Befüllen und Entleeren wird durch zwei gegenüberliegende Ausgießvorrichtungen (Tüllen) erreicht, wobei der Anwender darüber entscheiden kann, welche der beiden Öffnungen für welches Vorhaben benutzt werden soll.

Da Ping-Pong-Bälle leichtgewichtiger sind als Wasser, wurde die Idee entwickelt, die Hohlräume der Bälle mit Sand oder Granulat zu füllen. Diese Modifikation würde einer der Wirklichkeit entsprechenden Simulation zu gute kommen, da das Objekt bei Entleerung an Gewicht ab- und bei Befüllung zunehmen würde. Hinsichtlich der Erzielung eines realistischen Testverfahrens kann dieses Verfahren realistischere Situation widerspiegeln.

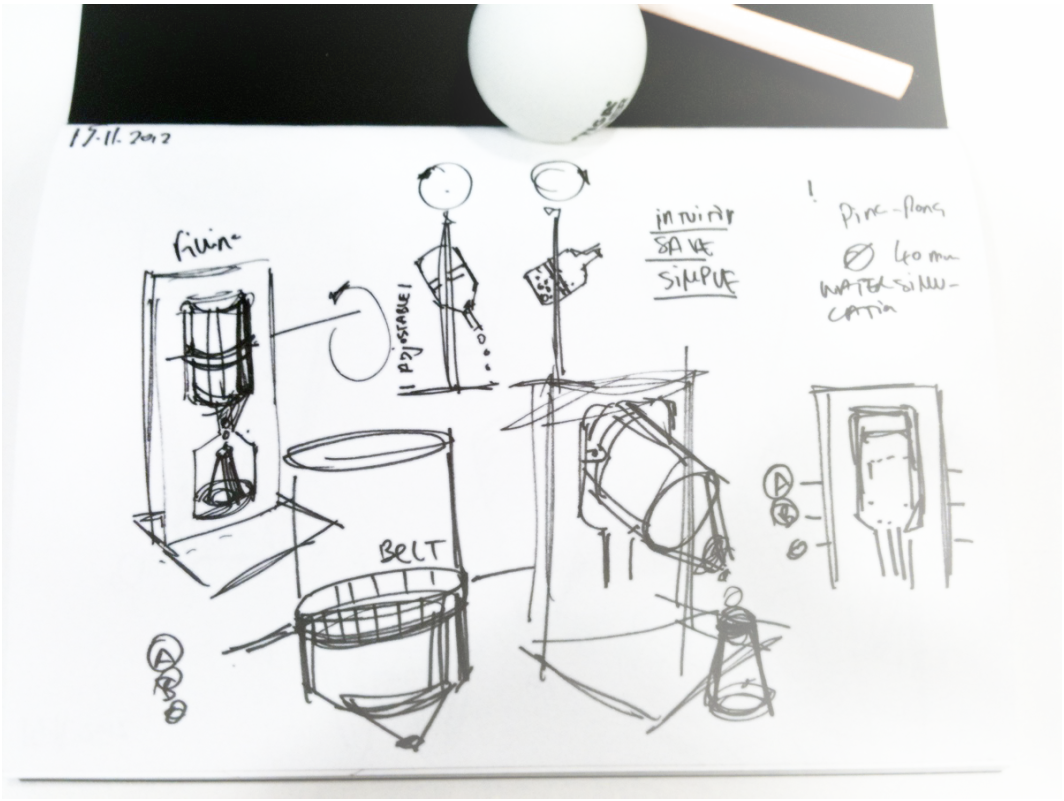


Fig. 5.34 Planungsskizze des Autors

Der Autor entschied sich jedoch in dieser Phase der Praxis, die Testverfahren ohne zusätzliche Befüllung durchzuführen, da das Ziel der Anwendung eine Feststellung von diversen Handhabungsmustern und weniger eine auf ergonomischen Faktoren basierende ist.

Mit dem Ziel der Anwendung von P3 durch externe Personen, Personen, die nicht an der Entwicklung beteiligt sind, wagte der Autor den Schritt heraus aus der “Laborwelt” durch die Nachbildung eines Alltagsszenarios in der simulierten Realität. Ziel der Anwendung: Identifizierung von unterschiedlichen Handhabungsmustern, differenzierbar in Körpergrößen (anthropometrische Daten) und deren Handhabungsmustern mit Objekten der Simu9lation (Heißwasser-Zubereitung) Nach Testphase mit Prototyp 1 und 2 wurde die Methode der Berührungsmatrix mit den überkreuzliegenden Rastern aus leitfähigem Garn mit folgenden Zielen weiterentwickelt. Die Methode der Berührungsmessung soll nun auf ein Produkt aufgelegt werden, mit dem der Anwender – beobachtet und registriert durch den Autor - praktisch-räumliche Aufgaben erfüllen soll. Diese Aufgabe gilt es mit dem Produkt als Werkzeug erfolgreich zu meistern. Der Anwender soll im Gegensatz zum P2 (Vert 8x8) bestimmte, geplante, definierte Handlung vollziehen. Obwohl diese Handlungen im Vorfeld geplant und definiert sind, bieten sie genug Handlungs- und Interpretationsspielraum, um die Ermittlung möglichst unterschiedlicher Daten über Bewegungsmuster und gleichzeitig eine Berücksichtigung und Einbeziehung unterschiedlicher Anwendergruppen zu gewährleisten. So ist es im Vorfeld der Anwendung wichtig, über beteiligte Personen der Nutzungsanwendung zu entscheiden, um exakt auf deren Bedürfnisse einzugehen. So sollten eingesetzte, benutzte Objekte und Einrichtungsgegenstände Körpergrößen und andere Eigenschaften der Anwender (Probanden) widerspiegeln. Es wurde die Einbeziehung unterschiedlicher Tischhöhen (und Durchmesser von Griffen) eingeplant, um eine gute Zugänglichkeit von verschiedenen Personengruppen, z.B. Kindern und Frauen, zu gewährleisten.

Die Anwendung mit P3 hat zum Ziel, die Bewegungsmuster unterschiedlicher Menschen zu registrieren. Sie hat deshalb als Grundlage, eine möglichst frei zugängliche Umgebung zu gestalten, um nicht Menschen auszugrenzen, die jenseits des Standards liegen. Störungen und Irritationen aufgrund ergonomischer Mängel bei der Gestaltung der Objekte und Einrichtung sind zu vermeiden.

So war die Idee bei P1 (Sphere/Globe 16 FSRs), Berührungen sichtbar zu machen, die sich in ihrer Art und Weise unterscheiden: Fangverhalten mit beiden Händen, Aufnehmen des Balles et cetera. So ist das Ziel bei der Weiterentwicklung mit P3 (Sensing Pot 16x16) nicht mehr die Techniküberprüfung allein, sondern vornehmlich die Datenermittlung mit unterschiedlichen Nutzern. P2 diente der Überprüfung der Möglichkeiten einer Berührungsmessung mit gewählter Technikmethode der Umspannung eines Körpers mit einem Netz aus leitfähigem Garn.

Fig. 5.35 Von a nach b

Fig. 5.36 Basis

Fig. 5.37 Verkabelung zwischen CPU und Sensing Pot (P3)

Fig. 5.38 Set-up

Fig. 5.39 (oben) Inspektion durch Proband Anwendung durch Probanden und Beobachtung Fig. 5.40

Fig. 5.41 Greifverhalten A

Fig. 5.42 Benutzung von Sensing Pot (P3) von Probanden

Fig. 5.43 Überlagerung der Aufnahmen bei Usertesting 1 (Aufsicht 1)

Fig. 5.44 Überlagerung der Aufnahmen bei Usertesting 1 (Aufsicht 2)

Fig. 5.45 Überlagerung der Aufnahmen bei Usertesting 1 (Frontansicht 1)

5.8.2 P3 Fazit

Die Aufforderung, mit dem Körper P3 möglichst viele Bälle von der gefüllten linken Schale A in die zu Beginn leere Schale B zu befördern, wurde von allen Teilnehmern positiv wahrgenommen und beurteilt. Die Aufgabe war intuitiv, körperlich und geistig leicht ausführbar (und stiftete bei den Teilnehmern Vergnügen).

Der Prototyp 3 (P3) wurde ausschließlich mit der Matrix A (Bild) von 16 Reihen und 16 Kolumnen eingesetzt. Die Matrix ergibt bei den 16 Reihen eine horizontale Distanz von 15 mm und bei den 16 Kolumnen vertikal 18 mm. Das engmaschige Netz im Vergleich zu P1 und P2 ergibt flächendeckende Messungen, da es weniger blind spots zulässt. Dies erwies sich als vorteilhaft für die Erkenntnisgewinnung[2].

Probanden: Auswahlverfahren (Usability-Test)

Es nahmen ingesamt 8 Testpersonen im Alter von 2-40 Jahren an dem User-Testing mit P3 teil, davon 2 Kleinkinder, zwei Frauen (eine schwanger) sowie 4 Männer. Der Autor beabsichtigte durch seine Probandenauswahl möglichst verschiedene Körpergrößen erfolgreich messen zu können. Eine zweiter Anwendertest (Anwendung 2) ist mit Teilnehmern geplant, die besonders jung (2 Jahre), alt (68-72 Jahren) oder körperlich eingeschränkt sind. Daraus ergeben sich, so vermutet der Autor, im Umgang mit dem Einsatz handelsüblicher Serienprodukte unterschiedliche Berührungsmuster. Die Messungen laufen bei 16 Reihen und 16 Kolumnen stabil und wiederholbar, mit einer exakt drei-sekündigen Zeitverzögerung ab. Die Bildfrequenz der Videobeobachtungen kann an die Bildfrequenz der Messungen angeglichen werden. Durch die Synchronisierung der Videos der Berührungsmessung, Handhabungsabläufe der Personen mit Kamera in Frontansicht und Draufsicht kann die Qualität der Messungen überprüft werden.

Erkenntniss durch Anwendung 1 - Analyse der Rasterbilder (256 Rasterzellen)

Der Autor kann nach Auswertung der Daten unter Berücksichtigung der Information

von und mit Abgleich durch Videobeobachtungen folgende Hauptaussagen treffen:

- Messbilder von Kleinkindern unterscheiden sich eindeutig von denen männlicher

Probanden

- Messbilder lassen auf eine beidhändige Benutzung der Kleinkinder sowie der

schwangeren Frau erkennen

- Einhändige Benutzung durch männliche Teilnehmer

- Nutzung durch Kleinkinder ergaben Messbilder, die Aktivitäten in den unteren Reihen

und Kolumnen des Rasters anzeigten

2 Die Messungen der Matrix B (Abb.) mit 32 Reihen und 32 Kolumnen, die zeit- und baugleich in dem P3 montiert ist, und somit 32 Messflächen mit jeweils einer Größe von 7,5 mm (horizontal) x 9 mm (vertikal) darstellt, hat aufgrund der Bauweise des Microcontrollers mit 16 analogen Steckplätzen zum Zeitpunkt der Messvorgänge des User-Testings (1) nicht funktioniert.

Die Erkenntnis, dass verschiedene Oberflächenmaterialien der eingesetzten Prototypenreihe (Papier, Neopren, Leder) und deren haptisches Wahrnehmen durch die Probanden unterschiedliche Handhabungen hervorrufen und natürliche Nutzungsweisen verfälschen, gilt es in der nächsten Phase des User-Testing zu berücksichtigen. Der Autor sieht vor, mit gleichen Produktoberflächen zu arbeiten, um eine konstante Größe innerhalb der Anwendungsforschung zu setzen.

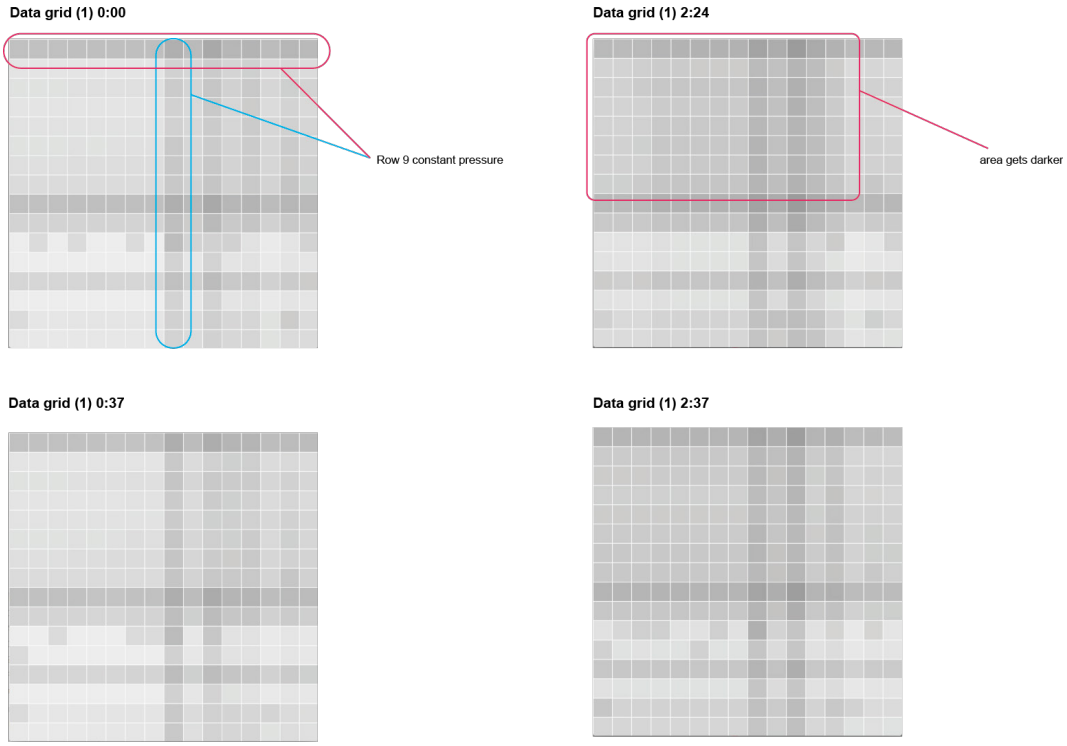


Fig. 5.46 Nutzerkarten (16 Reihen & 16 Spalten) mit Analyse der Fehlerquellen, Dirty data and bugs.

5.9 Ausblick

Welche Aussagen und Erkenntnisse erhofft sich der Autor von einer weiteren Entwicklungsphase und der Gestaltung eines weiteren Prototyps? 1) Weiterentwicklung der Methode mit dem Ziel, Personen mit körperlichen Einschränkungen (o.ä.) und deren potentielle Probleme und Hürden im Umgang mit Produkten zu identifizieren. D.h. Messsystem verfeinern (Dichtheit der Matrix u.a.), und Anwendung mit geeigneten Probanden (Zielgruppe/Inklusion) widerholen.

6. Einsatz der Berührungsmessung bei handelsüblichen Serienprodukten. Ermittlung und Überprüfung der Daten dieser Messmethode bei Objekten, die nicht spezielle Prototypen sind

6.1 Für die Durchführung eines Testverfahrens wurde ein einfaches dreidimensionales Objekt (Zitronenattrape aus Kunststoff) gewählt.

Folgende Ziele sollten verfolgt werden:

Um die Methode der Berührungsmessung im Rahmen der Forschungsarbeit überprüfen zu können, entschied sich der Autor nach den Phasen der Prototypenentwicklung, die Herangehensweise zu ändern. Eine Validierung des Methodenansatzes liegt dann vor, wenn das Messsystem in der Lage ist, wiederholt und stabil unterschiedliche Körpergrößen unterscheidbar und erkennbar zu machen. Die Entwicklung und Gestaltung spezieller Volumenkörper als Platzhalter für zu erwartende Berührungsaktionen ist erforderlich, um ein definiertes Anwendungsszenario zu gestalten. Die Methode der berührungssensitiven Prototypen ist technisch begründet in der Einbettung der Messhaut und Unterbringung der Hardware in einem Hohlraum für einen freien, kabellosen Einsatz. Mit der Verwendung von handelsüblichen Gebrauchsobjekten als Hüllen der Berührungsmessung kann eine Evaluierung der Methode unter realen Bedingungen (Produktwelt) vorgenommen werden. Hierbei kann die Machbarkeit der Messmethode und ihr Einsatz im realen Umgang mit Produkten - ohne Objektsimulation - beobachtet und geprüft werden. In der nächsten Praxisphase soll festgelegt werden, in welcher Form das Messsystem ausgebildet werden muss, um bei unterschiedlichen Gebrauchsobjekten und unterschiedlichen Nutzern wiederholt und stabil Daten der Berührungen zu ermitteln. Eine besondere Herausforderung stellt die Fixierung des Messgewebes auf dreidimensional ausgeformten Körpern (Freiformflächen) dar. Zudem wird das Ziel der Prototypenentwicklung P3 und P4 mit der Verfeinerung der Sensormatrix in Bezug auf die Auflösung der Berührungskarten (Seite 37, dritter Zwischenbericht vom 5. Februar) thematisiert. Der Forscher erhöht nun nicht nur die Anzahl der Messreihen und Spalten (Komplizierung von Hardware und Software), sondern verkleinert die gesamte Messfläche bei gleichbleibendem Matrixformat. Es soll der Zusammenhang untersucht werden, welche Auswirkungen eine Verkleinerung der sensitiven Fläche in Bezug auf die Kenntlichmachung von Nutzungsverhalten sowie von unterschiedlichen Körpergrößen hat. Die Untersuchungen kleinvolumiger Körper sollen auf großflächige, komplexe Gebrauchsgegenstände übertragen werden. Der kommende Forschungsschritt mit handelsüblichen Gebrauchsgegenständen soll darüber Aufschluss geben.

Die zu erwartenden Berührungskarten (mapping) liegen derzeit im zweidimensionalen Raum auf der Ebene mit X- und Y-Achse vor. Es ist jedoch beabsichtigt, die Karten (sensor maps) im dreidimensionalen Raum (mit X-, Y-, Z-Achsen) virtuell auf die Flächen der berührungssensitiven Körper zu projizieren und als Animation ablaufen zu lassen. Der Autor erhofft sich dadurch, bei Designern für ein ausreichendes Verständnis beim Lesen und Anwenden der Berührungsdaten zu sorgen. Für dieses Ziel benötigt der

Forscher und Anwender die Koordinaten der Flächen zur Erstellung der Projektionflächen für die Darstellung der Berührungskarten. Ausblick auf Wissenstransfer: Eine weitere Herausforderung stellt die Vermessung des Volumenkörpers dar (Laser scanning/ Reverse engineering), da eine Flächenberechnung für die Erstellung der Körper in CAD Programmen nötig ist, um später Berührungskarten zu projizieren. Aus den Erkenntnissen aus der Prototypenentwicklung (P1-3) und der Diskussion im Kolloquium (Weimar 5.2.2013) resultiert der Ansatz, die Verwendung von Serienprodukten, z.B. Werkzeugen oder anderen Objekten, als Platzhalter zur Überprüfung der Berührungsmessung in Betracht zu ziehen. Die Entwicklung spezieller Prototypen, P1, P2 und P3, wurde geprägt von dem Bestreben, eine berührungssensitive Hülle (zur Interaktion mit Probanden) zu schaffen. Dieser Ansatz mündet bei P3 in der Definition einer Zusatzfunktion, die von Probanden unter Beobachtung erfüllt werden muss.

Die Verwendung eines existierenden Produkts mit einer klar definierten Aufgabe erleichtert die Entwicklung von Versuchsreihen erheblich, da der praktische Nutzen bereits gezeigt wurde und der Gebrauch etabliert ist. Eine neue Herausforderung der Technikentwicklung stellt jedoch die Einbettung der Messtechnik (Hardware, wiring) und das Auflegen der Messhaut auf die Oberfläche (dreidimensionale Ausformung) des Produkts dar. Die eindeutige Definition der Funktion kann der Autor verwenden, da der Anwender bereits ein Verständnis für die Art und Weise der Nutzung und den Ablauf der Handhabung entwickelt hat. Es besteht somit weniger Bedarf, die zielorientierten Aufgaben, wie z.B. Partikelbefüllung und Entleerung von Hohlkörpern, zu definieren und gegenüber den Probanden zu äußern.

Die Umkehrung des Methodenansatzes - von der Entwicklung eines künstlichen Messkörpers mit einer simulierten Funktion (Heißwasser-Zubereitung) zu der Verwendung eines realen Serienprodukts mit integrierter Berührungsmessung - stellt einen bedeutenden Schritt im Hinblick auf die zeitnahe Validierungsmöglichkeit der entwickelten Methode (der Berührungsmessung) dar.

Das Forschungsziel des Autors ist es, eine Methode zu entwickeln, die

1) den Kontakt von Nutzern (auf Produktflächen) auf Basis der Berührungsspuren sichtbar und lesbar macht (Decodierung)

2) den Designer unterstützen kann, Daten (Berührungskarten) über den realen Gebrauch von Produkten - für die Produktoptimierung im Hinblick auf die Inklusion - zur Verfügung zu stellen

Die bisher verfolgte Herangehensweise, einen berührungssensitiven Volumenkörper zur Ermittlung von Berührungsdaten zu entwickeln, führt den Autor zur Verwendung von handelsüblichen Produkten. Um Daten über Position und Druck zu ermitteln, werden diese mit einer sensitiven Oberfläche versehen. Daraus ergibt sich folgender neuer Kriterienkatalog:

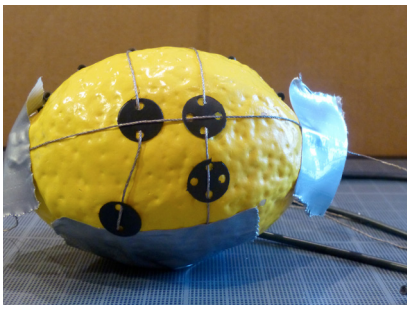


Fig. 6.1 Zitronenattrape Montage

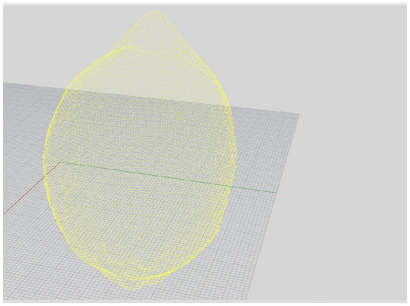


Fig. 6.2 Laserscan Zitronenattrape (Rhinoceros Bildschirmdruck)

1) Dichte der Matrix soll so gewählt werden, dass eine Erscheinung des Produkts durch das Auflegen der Messhaut gewährleistet ist.

2) Die primäre Funktion des Produktes sollte nicht beeinträchtigt werden.

3) Kabellose Anwendung ist zweitrangig (d.h. Kabelbaum zur CPU akzeptabel).

Vorläufige Zielsetzung: Vorerst Beantwortung der Frage: Kann der Autor nach der Anwendung von P1-3 definieren, dass es mit der angewandten Methode der Berührungsmessung möglich ist, Körpergrößen unterscheidbar zu machen?

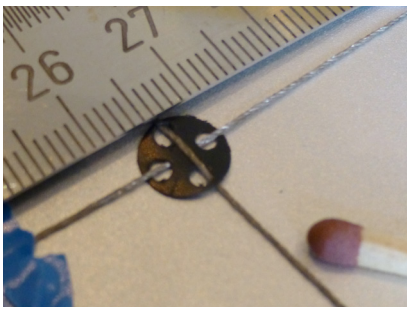


Fig. 6.3 Knotenpunktdesign (Velostat)

Umsetzbarkeit: Dieser Ansatz verlangt, Teile der Technik zur Berührungsmessung (Technik/ Hardware) auszulagern, Komponenten extern zu platzieren und das Messwerkzeug mit einer Kabelverbindung zu versehen.

Folgende Ziele sollten verfolgt werden:

1) Abtasten der räumlichen Flächenkoordinaten des Objektes durch Flächenrückführung (Reverse engineering)

2) Anbringung der Messstruktur auf die Oberfläche (Freiformflächen) des Objektes, um Berührungen des Objektes zu registrieren

3) Berührungen dreidimensional auf die 3D Fläche des Objekts projizieren

Um die Oberflächen des Objektes räumlich zu erfassen, hat der Autor einen Laserscanner verwendet. Die räumliche Ausformung des Objektes liegt nun in Form von Punktwolken in einem Koordinatensystem mit drei Achsen (XYZ) vor.

zu1) Der Autor plant, Verfahren wie die des taktilen Abtastens oder Laserscannings zu verwenden, um die realen Flächen des zu vermessenden Objektes in ein virtuelles Flächenmodell umzuwandeln. Hintergrund dafür ist das Ziel, ein möglichst realistisches und

akkurates Darstellungsformat der Berührungsdaten im dreidimensionalen Raum (virtual reality) zu erreichen. Die Datenvisualisierung der Berührungsmessung stellt ein wichtiges Kriterium in partizipatorischen Designprozessen dar. Relevante Informationen sollten in einem Format präpariert und präsentiert werden, das auch von Nicht-Experten und fachfremden Teilnehmern leicht zu verstehen ist. Die Gleichstellung von allen beteiligten Entscheidungsträgern steht bei der Wahl einer Visualisierungsart im Vordergrund.

6.2 Planung einer Evaluierung von Gebrauchstauglichkeit durch Daten der Berührungsmessung

Weiterführend und als Ziel der Praxisforschung plant der Autor die Übertragung der Methode der Berührungsmessung auf reale Gebrauchsgegenstände, wie zum Beispiel Werkzeuge, Hand-held products etc.

Das Ziel der Anwendung ist es, den realen Umgang mit Produkten - ergänzend oder vollständig (Forschungsfrage) - durch die Ermittlung und Analyse von Daten der Berührungsposition und Berührungsdruck zu verstehen. Die ermittelten Daten sollen als Grundlage dienen, um handelsübliche Produkte hinsichtlich ihrer Gebrauchstauglichkeit zu überprüfen. Vor allem sollen Grundlagen geschaffen werden, um eine Diskussion und letztendlich eine Bewertung der Handhabung im Hinblick auf unterschiedliche Nutzergruppen auf Basis messbarer und überprüfbarer Kriterien durchzuführen. Dieser Ansatz unterscheidet sich grundlegend von der Evaluierung der Gebrauchstauglichkeit auf Basis nicht messbarer und nicht überprüfbarer Informationen. Diese wurden durch bisher etablierte Methoden des nutzerorientierten Designs zur Verfügung gestellt. Der Autor zählt Erkenntnisse und Wissen aus qualitativen Forschungsmethoden (soft data) wie zum Beispiel Observation, Shadowing, Interviews und User group testings etc. zur Kategorie nicht messbarer, nicht überprüfbarer und nicht wiederholbarer Daten. Ob die vom Autor entwickelte Methode im Gegensatz zur herkömmlichen Wissensermittlung eine gewinnbringende und für inklusive Entwicklungsprozesse förderliche Systematik beinhaltet, soll in der finalen Phase der Forschungsarbeit durch eine zweite Folge einer Anwendung (Usertesting) bewiesen werden (Ausblick).

Die Anwender, die an der ersten Folge des User-Testings beteiligt waren, verwendeten speziell für die Berührungsmessung gestaltete Prototypen, die als Volumina zur Kontaktherstellung zwischen Nutzer und Objekt ihren Zweck erfüllt haben. Der Autor beabsichtigt jedoch mit seiner Methode, die Überprüfbarkeit des Gebrauchs von herkömmlichen Produkten zu ermöglichen. Nicht nur primär unterschiedliche Funktionen, sondern auch sekundär abweichende Formen, Oberflächen und Ausrichtungen des jeweiligen Produktes lassen sich somit prüfen. Die Tatsache der Formabweichung stellt für die Übertragung der Methode der Berührungsmessung mit einer Matrix aus leitfähigem Garn eine technische Herausforderung dar. Dies gilt, da die zu umspannenden Oberflächen stets verschieden ausgeformt sind. Es muss eine Form der Anpassungsfähigkeit des Messsystems gewählt werden, die die Messmatrix flexibel einsetzbar gestaltet und stabil wiederholbar Daten liefert. Das System muß einfach montierbar sein. Dieses Ziel kann nur erfolgreich erreicht werden, wenn weitere Möglichkeiten der technischen Umsetzbarkeit praktiziert und exakt definiert werden.

Zu welchen Zeitpunkten in der Entwicklungs- oder Konzeptphase der Designpraxis sieht der Autor einen sinnvollen Einsatz der Berührungsmessung?

1) bei Einsatz der Berührungsmessung mit speziellem Prototyp

2) bei einem speziell mit Messtechnik ausgerüstetem Prototyp, wobei die Messtechnik und die Messvorgänge verdeckt ermitteln werden

3) bei Integration der Berührungsmessung in Serienprodukte

6.3 Blick und auf niederkomplexe Messtechnik und Begründung

Die Auswahl von Material und technischen Komponenten ist bei der finalen Phase der Methodenanwendung dementsprechend geplant, dass mittels einer leicht-verständlichen Bauanleitung ein Nachbau für jedermann entstehen kann. Der Autor entwickelte Richtlinien, die das Messsystem als niederkomplex, bestehend aus handelsüblichen Komponenten und verfügbarem Material, und im Hinblick auf Bau und Montage leicht nachvollziehbar, einfach und ohne fundierte Vorkenntnisse ausführbar macht. Die Philosophie des Open-Designs mit der Reproduzierbarkeit und dem knowledge sharing spiegelt in Teilen auch die eigene Herangehensweise des Autors und den Verlauf dieser Forschungsarbeit wider. Es liegt somit im direkten Interesse des Autors, die Erkenntnisse und Entwicklungen einer großen Hörerschaft (Online-Gemeinschaft) zur Verfügung zu stellen, da er selbst aus Quellen der free and open-source software Community geschöpft hat, um die in diesem Forschungsvorhaben angestrebten Ziele und persönlichen Interessen realisieren zu können. Die Verwendung von niederkomplexer Messtechnik (Hard- und Software) liegt im Interesse des Projekts, da die Optimierungsmethode den Anspruch hat, vielerorts von möglichst vielen Interessenten nachhaltig eingesetzt werden zu können. Die Verbreitung der Optimierungsmethode, die den Designern und Nicht-Designern Unterstützung bei der Bewertbarkeit von Produkten auf Basis eines Universal-Design Kriterienkatalogs liefern soll, durch hohe Anschaffungskosten zu schmälern, liegt nicht im Interesse des Autors.

6.4 Verfahren als Evaluierungsmethode des Universal Designs

Der Autor begibt sich mit der Durchführung von Anwenderszenarien mit Testpersonen in das Gebiet des Usability-Testings.

Innerhalb eines Usability-Tests werden Probanden aufgefordert, typische Aufgaben mit einem oder mehreren Produktprototypen zu bewältigen. Das Testverfahren spiegelt den Einsatz des Produkts in der Zukunft wider und soll helfen, Schwachstellen und Schwierigkeiten bei der Benutzung herauszufiltern, um diese im weiteren Verlauf der Entwicklung optimieren zu können. Der Autor beabsichtigt bei seinen Anwendungsszenarien reale Gebrauchgegenstände – keine Prototypen oder Beta-Versionen – einzusetzen, um Beobachtungen mit etablierten Produkten und Werkzeugen vorzunehmen. Diese Evaluierungsmethode unterscheidet sich von Methoden des Usability-Testings mit Modellen aus Entwurfsphasen, da die Anwendung lediglich auf den Prozess eines Interaktionsmusters und deren Unterscheidbarkeit abzielt und nicht auf Schwachstellen. Die Methode hat den Anspruch, Interaktionsmuster von Probanden unterscheidbar zu machen und zu vergleichen. Wenn das gelingen sollte, wäre die Fähigkeit der Methoden unter Beweis gestellt.

Eine Beurteilung dieser und anderer Schwierigkeiten im Umgang mit dreidimensionalen, greifbaren Produkten (Stichwort: Abbrecheranalysen) sind Ziele der Methode nach Abschluss der Entwicklung.

Die “Anwendung (1)” (Dezember 2012) mit dem Einsatz von Prototypen als reine Berührungshüllen oder -volumina und einer Simulation von Funktionen, Aktionen und ergebnisorientierten Aufgaben ergaben relevante Erkenntnisse über Interaktionsprozesse von unterschiedlichen Probanden, die sich in Alter und Geschlecht unterscheiden.

Die ermittelten Daten sollen Designer und andere Entscheidungsträger bei der Aufgabe unterstützen, Antworten auf Fragen der Ergonomie und Fragen zu anderen relevanten Bereichen (Humanfaktoren) zu treffen. So kann es beispielsweise von großer Bedeutung sein, wie hoch der Kraftaufwand bei einem Umfassungsgriff eines bestimmten Vorhabens war und ob die Ausformung eines Griffstücks sich generell ausreichend den Konturen von

unterschiedlichen Händen anpasst. Es ist zu klären, ob Griffbereiche überhaupt als solche genutzt werden sowie ihre Funktion erfüllen und ob die Ausformung eines Griffstücks mit den Händen unterschiedlicher Nutzer einen ausreichenden, kräftesparenden Formschluss bildet. Es ergibt sich die Frage, ob der Gestalter im Detail auf die Bedürfnisse, Anforderungen und Vorlieben der Nutzer unter realen Bedingungen des Gebrauchs Rücksicht genommen hat. Der Autor ist überzeugt, dass die Gestaltung von Produkten vor allem unter den Gesichtspunkten des Universal Designs durch die Verwendung neuer Prüfverfahren der Berührungsmessung verbessert werden muss. Um dieses Ziel zu verfolgen, bedarf es der Methoden, die vom Autor entwickelt wurden.

Mit der Methode der Berührungsmessung ist ein optimiertes Prüfverfahren erreicht. Es ist somit in zukünftigen partizipatorischen Produktentwicklungprozessen möglich, Designern oder anderen Entscheidungsträgern prüfbare Argumente zu liefern, die zu gesicherten Entscheidungen führen können. Mit dem Prüfverfahren ist es nun erstmals möglich, während des Gebrauches von Produkten mit gleicher Zielrichtung und gleichen oder ähnlichen Grundfunktionen, Berührungsdaten von Interaktionprozessen zu ermitteln, auszuwerten und zu vergleichen. Das Verfahren

- ist unter definierten Bedingungen einsetzbar und

- verzichtet auf foto- und videobasierte Mittel der Beschreibungen.

Das Verfahren verläuft ohne Beeinflussung der Probanden (ergo ohne Verfälschung der Daten), da der Proband sich nicht einer visuellen Beobachtung ausgesetzt fühlt und frei und unbeobachtet handeln und agieren kann. Auf den Einsatz von Technik für Foto- oder Videoaufnahmen, wie in der Ethnografie zur Beschreibung der in der Feldforschung gewonnenen Erkenntnisse üblich, kann verzichtet werden. Dies gilt, da die Berührungsmessung die Aufgabe der Dokumentation von Verhaltensmustern übernimmt. Der Wegfall von erkennbaren Beobachtungsmitteln und deren psychologischen Wirkungen schafft für die Probanden eine Umgebung, die jenseits einer Laboratmosphäre liegt und ohne pyschologische Stressoren auskommt. Der Ansatz gibt dem Evaluierungsteam die Möglichkeit, Produkte, beispielsweise anhand eines definierten Kriterienkatalogs mit Fokus auf Bedienungsfehler und Funktionsmängel, zu überprüfen. Es werden standardisierte, verlässliche und prüfbare Daten über Bedienungsfehler gewonnen und Ursachen dafür im Detail verstanden. Das Wissen über die Gebrauchstauglichkeit wird bei unterschiedlichen Nutzergruppen vergleichbar.

6.5 Die Problematik von `unarticulated user needs´, Nutzerzentriertheit und Inklusion

Die Tragweite eines unklaren Gebrauchsbedürfnisses eines Benutzers Unarticulated user needs (Leonard, Rayport 1997) innerhalb von Produktoptimierungs- und Innovationsprozessen verkünden o.g. Autoren in der Ausgabe (11/12.1997) des Harvard Business Reviews. Im nutzerzentrierten Design stellt die Problematik des Verstehens für die Bedürfnisse der Anwender eine schwierige Hürde dar. *`[…] encountering problems with your products or services that they don‘t know can be addressed and may not even recognize as problems´* (Leonard, Rayport 1997, S.107).

Hier kann die Methode der Beobachtung (Observation) ein geeignetes Mittel sein, um Verhaltensweisen in unmittelbarer Reaktion zu einer verbalen oder visuellen Stimulation zu studieren, mit dem Ziel, relevante, aber unausgesprochene oder diffuse Aussagen zu verstehen. Das Verfahren kann in Fällen, bei denen der mündliche von dem eindeutig gegensätzlich zu interpretierenden nonverbalen Ausdruck abweicht, angewendet werden. So ist es dem Forscher möglich, den Wahrheitsgehalt der Aussagen zu klären. In diesem Zusammenhang wird lediglich über Ziele einer Bedürfnisüberprüfung von Kunden gesprochen. Der Sachverhalt verhält sich jedoch weitgehend anders und wird komplexer,

meint der Autor, wenn es im Rahmen des Universal Designs darum geht, die Bedürfnisse möglichst vieler Menschen einer größeren Gruppe mit einem Produkt zu adressieren. Aus kommerzieller Sichtweise sollte es im Interesse des Produktentwicklers und des Unternehmens liegen, den Kreis der Käufer zu vergrößern und neue Käuferschichten anzusprechen. Ergebnisse bringen inklusive Designprozesse unter Berücksichtigung von Bedürfnissen einer weitgefächerten Gruppe.

7. Anwendung (Usertesting 2)

Im folgendem Text wird das Usertesting 2 auf Basis von Kap. 9: Einsatz der Berührungsmessung bei handelsüblichen Serienprodukten beschrieben.

7.1 Wahl des Methode und Begründung

Im Usertesting 1 (Kapitel 9) wurde die vom Autor formulierte, praktisch-orientierte Vorgehensweise „einer Umkehrung des Methodenansatzes zur Verwendung eines realen Serienprodukts mit integrierter Berührungsmessung“ in Kapitel 9 begründet. Für den User-Test 2 wurde ein handelsübliches Serienprodukt, in diesem Fall ein gebrauchter Akkusschrauber mit der Typenbezeichung Hilti SF 144-A3 ausgewählt.

Dabei greifen folgende Begründungen:

1) Simulation eines Gebrauchtauglichkeitsverfahrens, bei dem je nach Zielgruppendefinition verschiedene Probanden eingeladen werden, um die Betaversion eines Produktes zu benutzen und zu beurteilen. Da das vom Autor verwendete Präparat keine Betaversion, sondern ein im Handel erhältliches Serienprodukt ist, wird hier eine Gebrauchstauglichkeitstests geschrieben.

2) Das Produkt hat a) die primäre Funktion, die des Schraubens und Bohrens und b) eine sekundäre, zweite Funktion, die der Berührungsmessung während des aktiven Gebrauchs.

3) Davon ausgehend, dass die Probanden über ausreichend Wissen über die Handhabung eines Akkuschraubers verfügen, da es sich um ein Werkzeug handelt, das in den meisten Haushalten präsent und dessen Bedienung etabliert ist, muss kein Anwenderszenario simuliert werden, weil der Gebrauch eines Akkuschraubers für den Großteil von Anwendern unmissverständlich und intuitiv ist.

4) Die Verwendung und die Anbringung der entwickelten Berührungsmatrix auf verschiedene handelsübliche Produkte stellt einen bedeutenden Aspekt der Methodenentwicklung dar.

5) Der Autor hat sich mit dem Schritt der Anwendung 2 und mit der Übertragung der Methode in die Realität von Produkten und in das Arbeitsumfeld von Produktdesignern mit dem zum Ziel einer neuartigen Nutzerforschungsmethode genähert.

7.2 Planung des Aufbaus, Datenerhebung (Fragebogen) und Ziel der Anwendung

Der Autor beabsichtigte für die Dokumentation von Handhabungsabfolgen durch unterschiedliche Probanden folgenden Aufbau. Nach Ankunft der Teilnehmer hat der Autor die Probanden einzeln aufgefordert, einen Fragebogen auszufüllen, der persönliche Daten, Informationen zur Anfahrt und allgemeinen Lebenssituation abfragt. Diese Informationen sind für eine Einordnung der Probanden in Kategorien basierend auf körperlichen Eigenschaften und persönlichen Bedürfsnissen wichtig. Folgende Fragen wurden in den Kategorien gestellt:

1) Persönliche Daten: Alter, Geschlecht, Händigkeit (Angabe der dominanten Hand), Körpergröße, Schuhgröße und Beruf

2) Anfahrt: Wahl des Transportsmittel auf dem Weg zum Usertesting

3) Besondere Belastungen: Körperliche Herausforderung des Tages, der Woche, des Monats; Anfahrtsweg zur täglichen Arbeitsstelle, sportliche Tätigkeiten in der Freizeit und Sportart

Der Autor beabsichtigte mit der Wahl der Fragethemen, individuelle Informationen und Details über die körperlichen Beschaffenheiten (wie z.B. Fitness) der Teilnehmer, deren persönliche Eigenschaften, Herausforderungen und Einschränkungen zu erfahren. Auf Basis der Information über die Nutzer sollen sog. Personae entwickelt werden, die den Probanden, deren Umstände, Anforderungen und Bedürfnisse beschreiben. Mittels dieser Nutzerkarten kann der Autor die Daten der Berührungsmessung „decodieren“ und Erkenntnisse daraus in inhaltlichen Bezug zur jeweiligen Person und deren physische Eigenschaften setzen. Die Analyse der Daten kann den Autor dabei unterstützen, die (gewonnenen) Informationen einzuordnen und zu entschlüsseln sowie besser zu verstehen.

7.3 Beschreibung der Aufgabenstellung für die teilnehmenden Probanden

Die Probanden wurden aufgefordert einen Akkuschrauber zu benutzen, um eine festgelegte Anzahl von Schrauben in eine vertikale Tafel zu drehen. Bei Ankunft wurde den Teilnehmern mit einem Zahlencode ein durchnummeriertes Bohrfeld zugeteilt, dessen Nummer auf den Handrücken der jeweiligen Person für die Kameras sichtbar geschrieben wurde. Jeder Teilnehmer erhält einen Code z.B. H1, der fünf Bohrungen auf einer Tafel identifizierbar macht. Der Code beschreibt eine Bohrreihe mit Vorbohrungen im Abstand von 30 mm in einem Gesamtbereich der Größe (BxH) 120 mm x 270 mm. Die unterste Reihe liegt auf einer Höhe von 1400 mm und die oberste auf 1670 mm über dem Boden. Die Höhe der zu erreichenden Vorbohrungen resultierte aus einem ergonomischen Durchschnittswert der zu erwartenden Teilnehmergruppe. Beispielsweise waren Proband 1J bzw. 2A imstande den Akkuschrauber auf einer Arbeitshöhe von 1400 mm bzw. 1670 mm anzusetzen um die Aufgabe gelungen auszuführen. Alle Probanden waren körperlich in der Lage, die Aufgabe des Schraubens auf der jeweilig zugeordneten Höhe durchzuführen.

Observation und Dokumentation

Die Aktionen wurden durch Videoaufnahmen von zentral oben und von rechts aufgezeichnet. Diese Videoaufnahmen wurden in der Analyse mit den Messdaten des individuellen Berührungszeitraums (Arrays & Messwerte) des jeweiligen Probanden synchronisiert.

Fig. 7.1 Akkuschrauber (Seite)

7.4 Aufbau und Montage des Produktes

Der oben beschriebene Gegenstand (Akkuschrauber) wurde im Vorfeld der Anwendung 2 mit einer berührungssensitiven Matrix versehen (Abb.Kap10.4a). Die Entwicklung eines solchen speziellen Messprinzipes wurde von dem Autor nach Abschluss der Prototypenphase 1, 2 und 3 weiterentwickelt, modifiziert und (um)gestaltet. Die Messmethode kam nun bei dem finalen Usertesting erstmals zum Einsatz. Es wurde eine

Fig. 7.2 Griffdetail in Präparation für die Berührungsmessung

Überprüfung von Handhabungsmustern im Umgang mit handelsüblichen Werkzeugen und Gebrauchsgegenständen durchgeführt. Das Griffstück des Präparates wurde mit einer Matrix aus acht vertikalen Spalten und sechs horizontalen Reihen versehen. Dieses Messnetzwerk besteht aus 48 aktiven Messzonen, die sich gleichmäßig auf den Hauptbereich des Griffstücks verteilen.

Die Abstände der sechs Reihen varieren zwischen 7-9 mm. Die Abstände der acht Spalten liegen zwischen 9-12 mm. Diese Abweichungen kommen durch die freiformflächige Ausformung des räumlich komplexen Griffteils unter Einbeziehung der gleichmäßgigen Verteilung der Knotenpunkte zustande. Innerhalb dieser Abstände (Freiräume) kann das Netz keine Berührungen wahrnehmen. Diese Leerstellen sind Lücken im Messsystem. Für die Messungen von Halte- und Umfassungsgriffen sind sie aufgrund ihrer geringen Dimensionen für die Analyse der Messungen irrelevant.

Die 48 Messbereiche werden als in Graustufen variierende zweidimensionale Quadrate (Arrays) gespeichert und sind während der Anwendung für den Autor sichtbar. Ergänzend zu der Darstellung von Rasterzellen als Animation, wurden die Messwerte in einem Textdokument gespeichert.

Die externe Messeinheit aus Microcontroller (Arduino Uno), Widerständen und Kabelverbindungen aus leitfähigem Garn sowie Verdrahtung wurde, ohne den Fluss der Handhabung zu beeinträchtigen, separat an das Präparat lose angehängt. (Abb.) Diese Form der Unterbringung der Technik sollte akzeptiert werden und stellt einen massgeblichen Unterschied zu den Prototypen 1-3 dar, bei denen die Komponenten verdeckt im Gehäuse untergebracht waren.

Fig. 7.3 Aufbau und Montage des Produktes

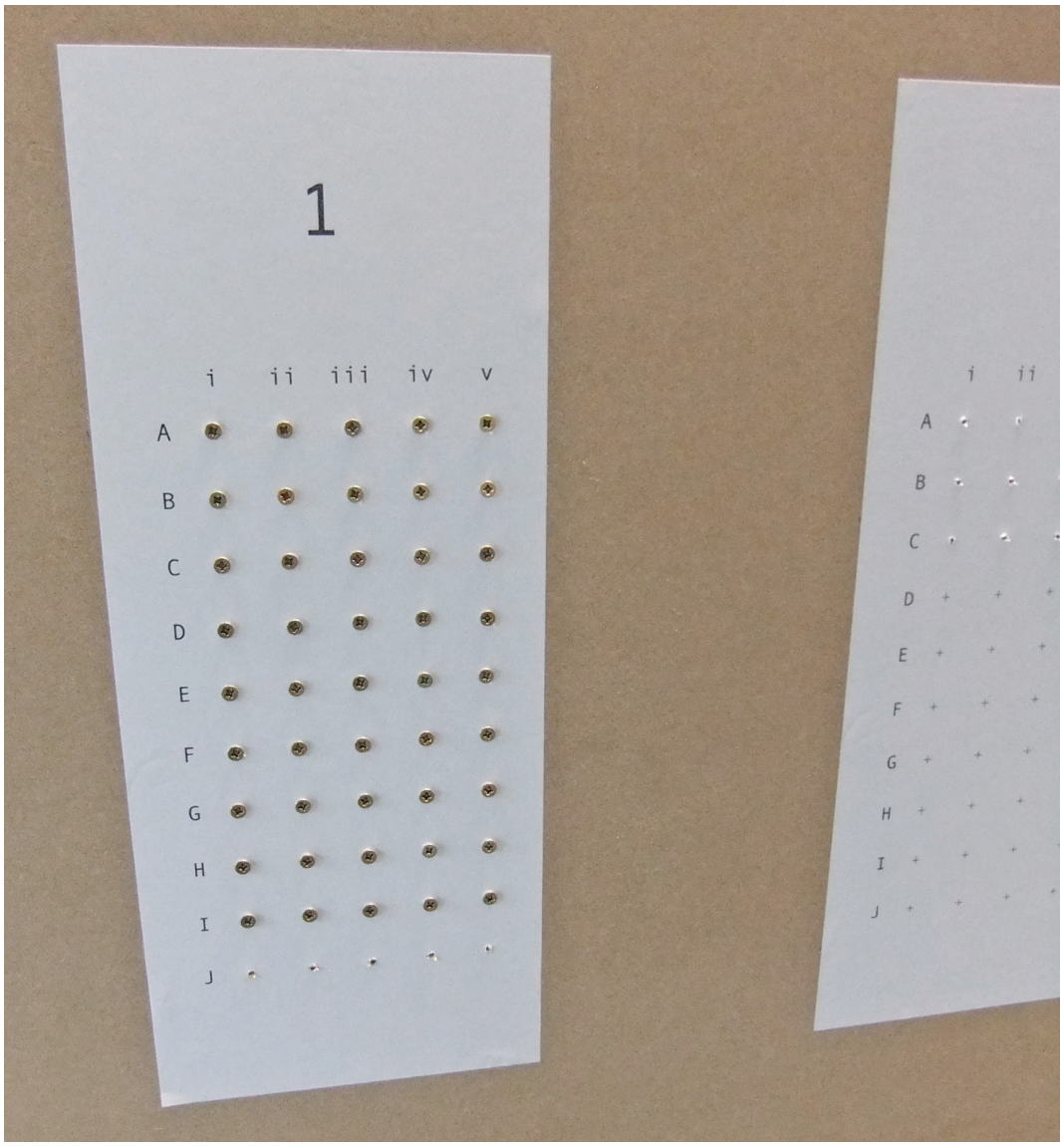


Fig. 7.4 Bohrfelder nach Hälfte des Usertesting 2

Fig. 7.5 Montage des Produktes (Entwurf der Knotenpunkte mit Plättchen aus Velostat): Eigenentwicklung des Autors

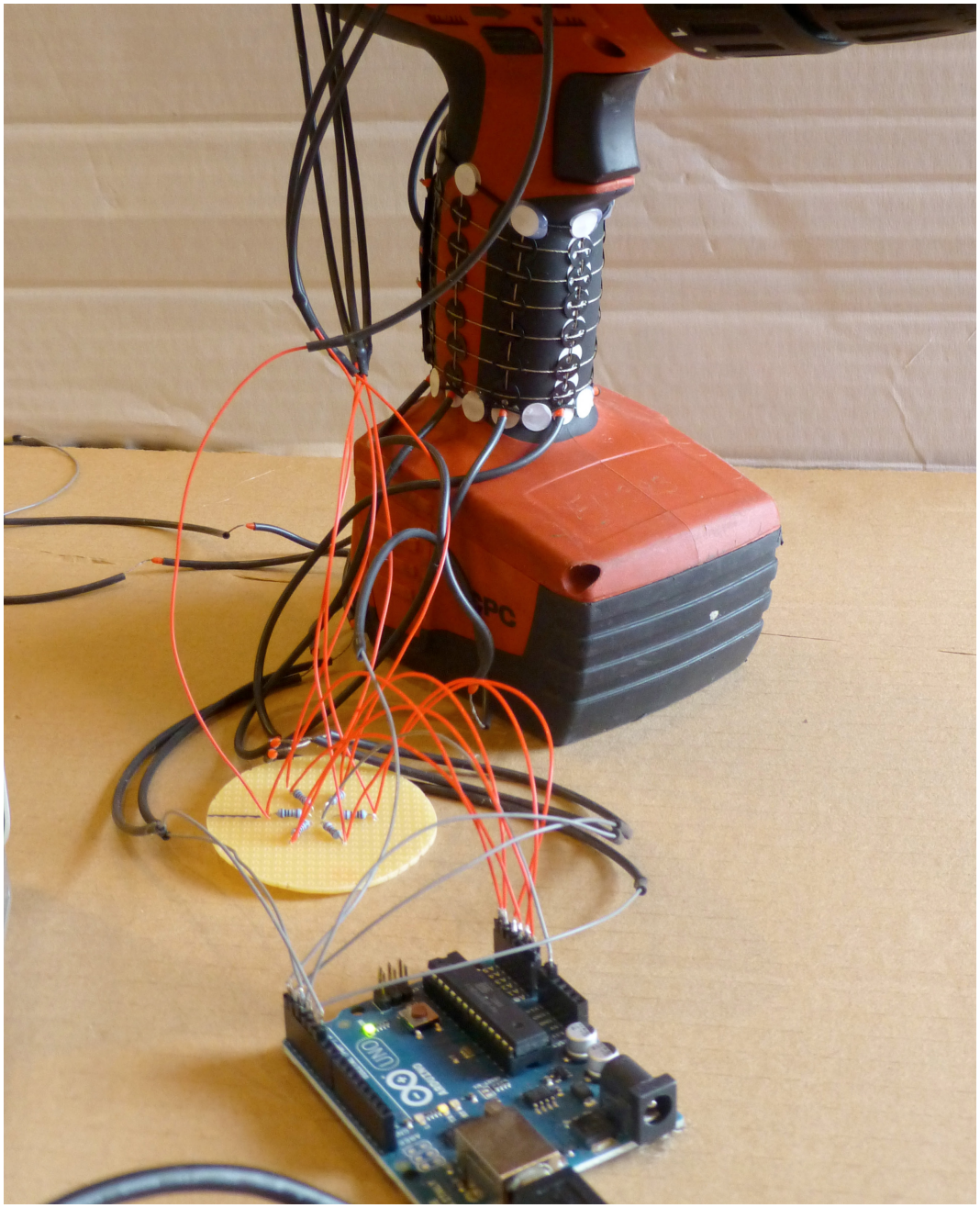


Fig. 7.6 Präparat mit Arduino Uno (Microcontroller)

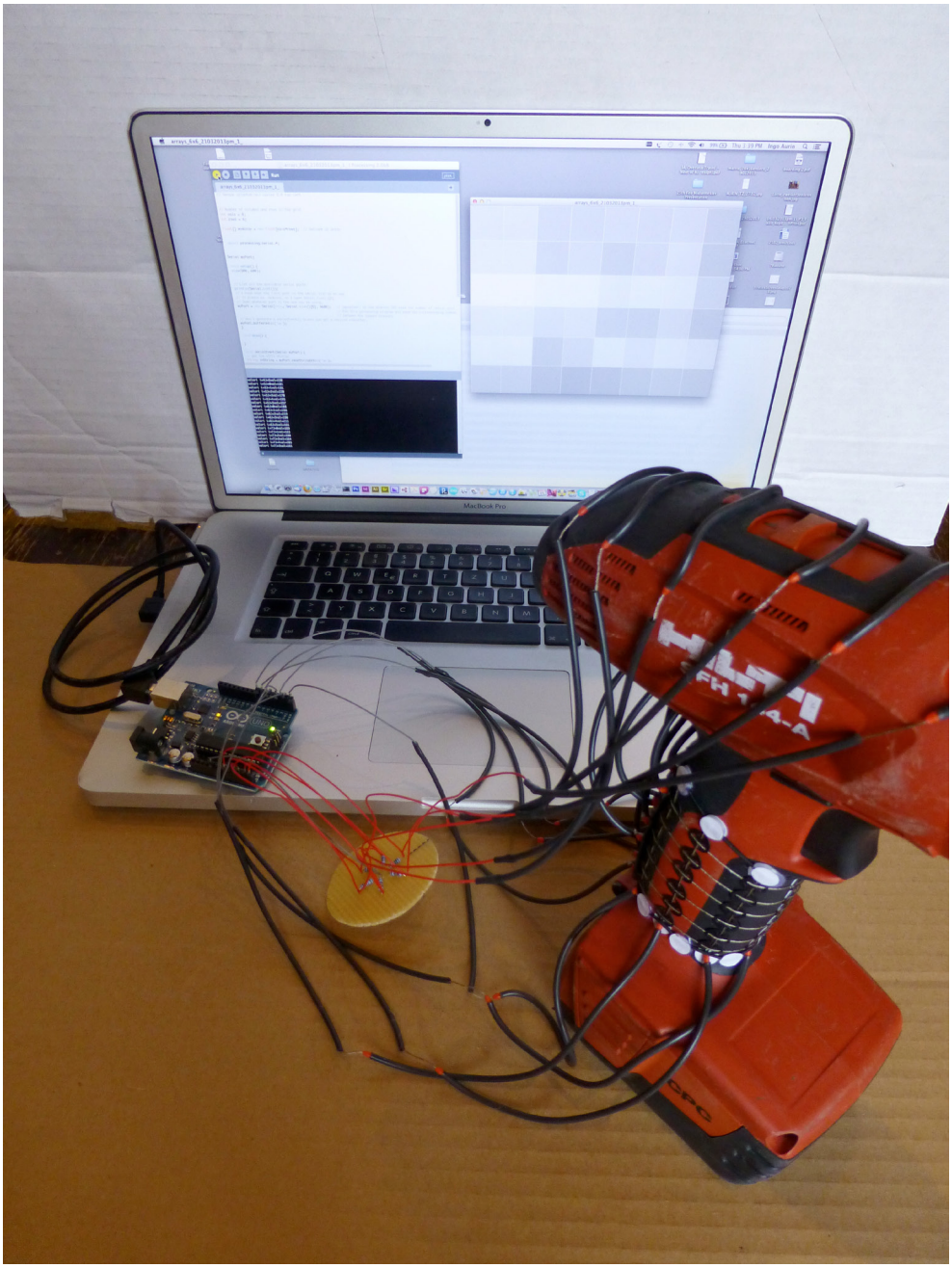


Fig. 7.7 Verbinden von Hardware und Software

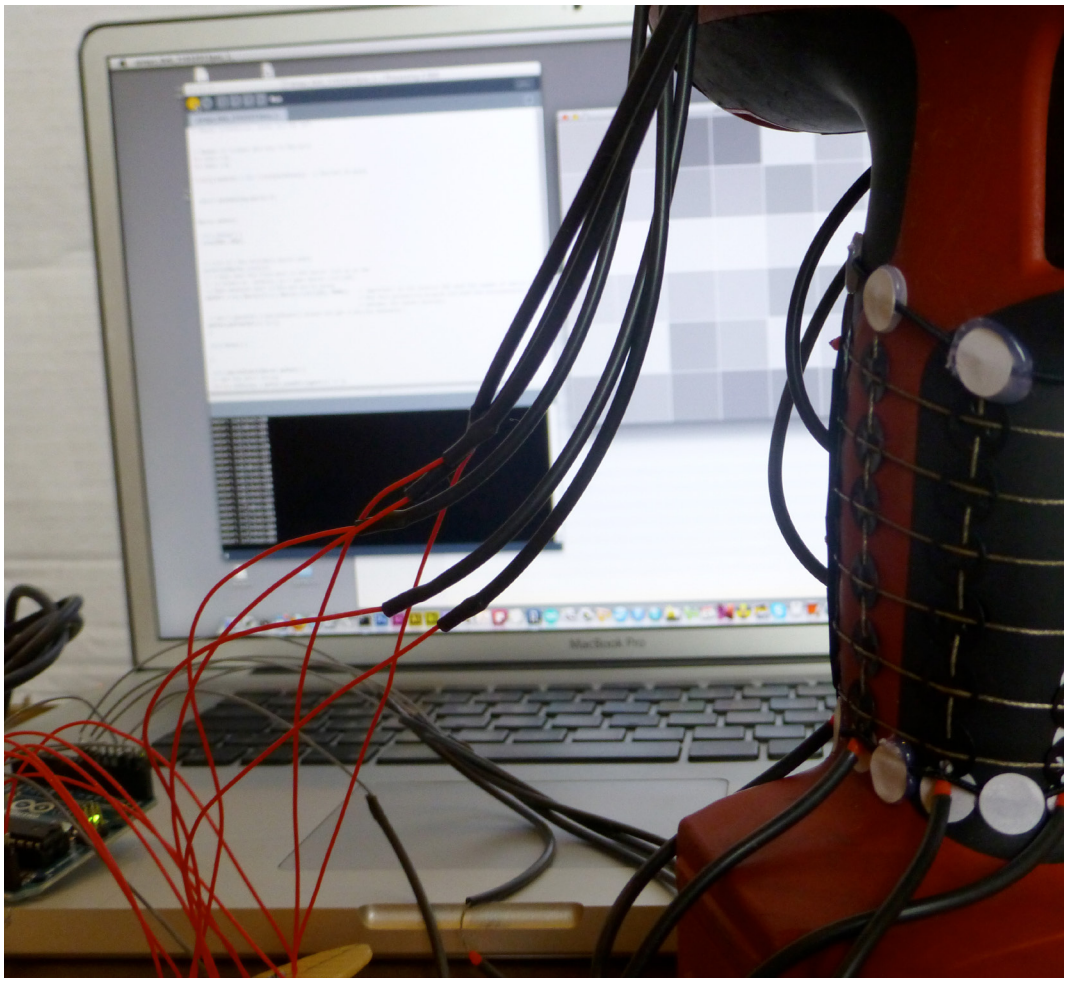


Fig. 7.8 Präparat mit berührungssensitver Matrix (6 Reihen & 6 Spalten)

Fig. 7.9

Fig. 7.10 Präparat mit berührungssensitver Matrix

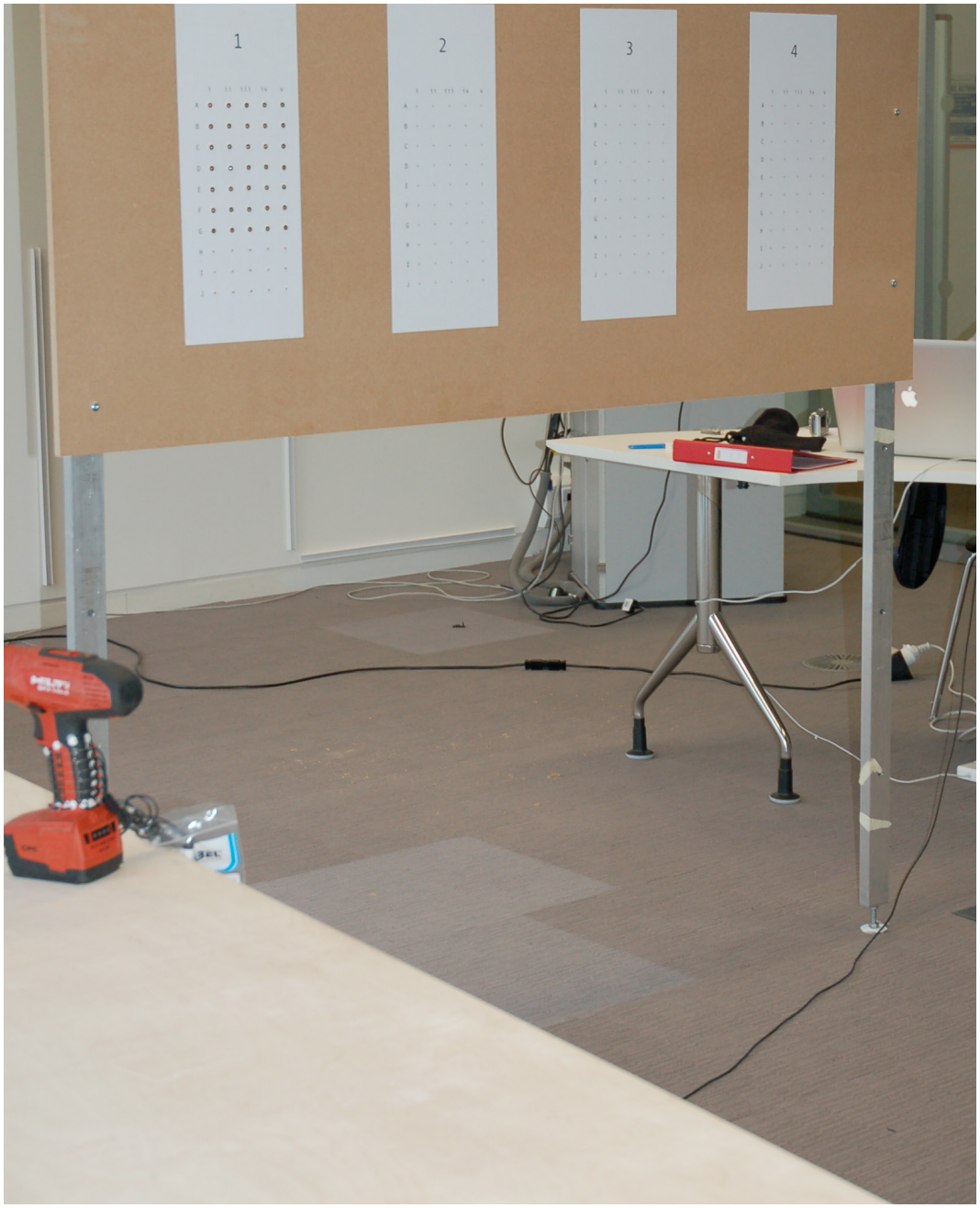


Fig. 7.11 Aufbau des Usertesting 2

Proband 1D (0:48)

211	165	165	165	211	211
205	205	232	232	205	204
200	200	232	232	205	200
251	251	251	251	251	251
232	232	232	232	232	232
199	192	165	165	232	178

Fig. 7.15 (oben) Proband 1E Nutzerkarte mit Messwerten: Fehlerquellen aufgrund von Verdrahtung in Reihe 2 von unten (konstanten Messwert 251)

Fig. 7.16 Ansetzen des Akkuschraubers

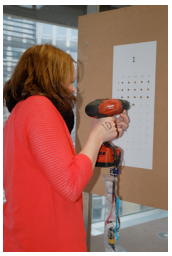
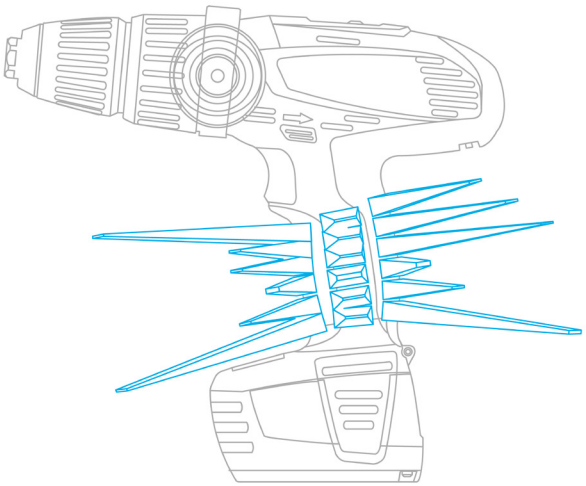


Fig. 7.17 Proband in Aktion

7.5 Beschreibung des Ablaufs des Usertestings

Es nahmen insgesamt 13 Personen, davon acht männlich und fünf weiblich zwischen 25 und 43 Jahren, an dem Testverfahren teil. Alle Teilnehmer konnten die gestellte physische Aufgabe des Eindrehens von einer definierten Anzahl von Schrauben in das vorgesehene Bohrfeld erfolgreich erfüllen. Alle Teilnehmer haben zudem alle zwölf Fragen des Fragebogens vor Beginn der Anwendung beantwortet. Im folgendem Text werden drei der 13 Probanden beschrieben, deren individuelle Handhabungsmuster in Form eines Nutzer-Steckbriefes erläutert werden. Die Daten der Berührung ergeben folgende Annahmen, die mit Hilfe von ergänzenden Methoden der Nutzerforschung bestätigt werden sollen. Zu diesen Methoden gehören im Rahmen des Usertestings 2 Videoaufnahme unter verschiedenen Blickwinkeln und die Datenerhebung durch den Fragebogen. Der Autor nennt den über die methodische Überlagerung von qualitativen Ansätzen der Nutzungsforschung (method overlay) erreichten Erkenntnisgewinn: Durch eine Datenprüfbarkeit validierte Beschreibungen von individuellen (Nutzer-)Charakteristika.

Nach Durchführung des Usertestings 2 kann der Autor mit Hilfe der in der Praxis eingesetzten Berührungsmatrix folgende grundlegenden Aussagen machen: Die Bilder (Arrays) ergeben, dass im oberen Bereich des Griffstücks allgemein ein hoher Kraftschluss zwischen Hand und Griff entstand (Erkenntnis 1). Die Berührungskarten zeigen, dass ein lineares Verhältnis zwischen der Umfassungsweite (Spannweite der Handinnenfläche) und dem Kraftauftrag besteht (Erkenntnis 2).



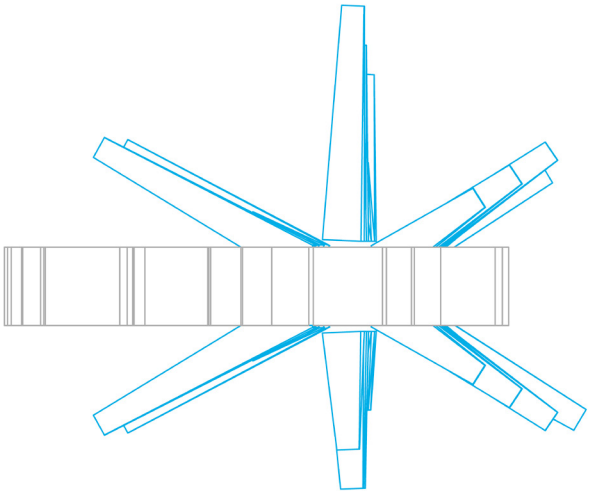


Fig. 7.18 3D Visualisierung von Proband 1D Nutzerkarte auf Basis der Messwerten: Illustration zeigt Lücken (links offen) im Greifen (unten) und feste Druckauflage auf der rechten Griffseite

Das Berührungsbild von Proband 1D läßt die Erkenntnis (2) zu, dass der Umfassungsgriff auf der linken Seite des Handgriffs eine Lücke hinterlässt, in der im Moment der Aktion kein Auflagedruck ausgeübt wird. Daraus läßt sich rein durch das Lesen der Sensor map ableiten, dass der Akkuschrauber vermutlich mit der rechten Hand benutzt wurde. Die Berührungskarte des Proband 1D als Quelle der Daten erklärt diesbezüglich - ohne einen Abgleich mit weiteren Untersuchungsmethoden z.B. Videoaufnahme oder Datenerhebung - die Präsenz eines Nutzers, der das Produkt zur Erfüllung der Aufgabe mit der rechten Hand verwendet. Dabei macht die Berührungskarte deutlich, ob der Proband eine kleine oder große Hand besitzt. Ein kontaktfreier ergo druckfreier Bereich am Präparat erscheint in der Sensor map als Bereich hellgrauer Rasterzellen, ein belasteter Bereich dunkelgrau. Der Bereich zwischen Fingerenden und Handballen resultiert aus der maximalen Spannweite der gesamten aufgelegten Handinnenfläche im Verhältnis zum Profilumfang des Griffstücks. Die räumliche Distanz ist in der Realität ist auf dem Bildschirm durch einen Wegfall einer Kontaktfläche zwischen Hand und Griffumfang sichtbar. Ein kleine Hand ist nicht in der Lage aufgrund des Umfangs bzw. Querschnitts des Griffstücks einen kompletten Umfassungsgriff zu formen. Dies bestätigt die Berührungsgmessung anhand der Sensor map.

Der Autor muss zum Stichwort anthropometrische Messgrößen an dieser Stelle folgenden Absatz aus dem Bericht Every little counts - sense of security as a basic need for all zitieren: *`In the design practice the relevant data is missing in regard to design universally. The categorisation of people sizes into percentiles does not reflect the real population´* (Aurin 2011, S.3).

Zu dem Versuch einer Kategorisierung von Perzentilen und die darin, auf Basis von unbestätigten Annahmen, getroffenen Aussagen über die Anthropometrie von Nutzern, schreibt der Autor:

> [t]he estimations of human factors divided in percentiles provide practising designers only with a rough frame of criteria but the present system is unable to represent human factors all-encompassing and precisely. A 5th percentile woman does not evidently have 5th percentile extremities and a 50th percentile man has not evidently the physical strength as average. (ebd.)

Es wird somit deutlich, welch hohes Gewicht eine Überprüfung der parametrischen Daten der Berührungsmessung mit ergänzenden Methoden der Nutzerforschung hat, um gesicherte Aussage über individuelle reale Nutzercharakteristika zu machen/treffen.

7.6 Datenvisualisierungskonzept mit Flächenrückführung (Reverse engineering) zur Erzielung eines allgemeingültigen und allgemeinverständlichen Formats (im Hinblick auf den Einsatz in partizipativen Designprozessen)

Die Erkenntnis aus der erfolgreichen Fallstudie (Zitronenattrape) und den beinhalteten Schritten zur Vermessung und Übertragung eines realen Objektes in den virtuellen Raum können unmittelbar auf das Verfahren der Flächenrückführung mit dem aktuellen Präparat des Usertestings 2 übertragen werden.

Der Autor beabsichtigt, die Daten aus der Anwendung 2 durch die dreidimensionale Visualisierung verständlicher zu machen. Die Übertragung der zweidimensionalen Darstellungsweise der Rasterzellen (Arrays) reicht für ein den Erfordernissen z.B. für den Einsatz in partizipatorischen Designprozessen entsprechendes wichtiges Verständnis nicht aus. Die Daten der Berührungsmessung sollen in einer inklusiven Präsentationsform oder Darstellungsweise gestaltet sein, sodass die Informationen einer möglichst größeren Zuhörerschaft zugänglich gemacht werden kann. Das durch das Messverfahren ermittelte Wissen über den realen Gebrauchs eines Produktes soll bei mitwirkenden Entscheidungsfindungen den gleichen Stellenwert besitzen wie Zeichnung, Skizze, Abbildung oder das geschriebenes Wort. Der Autor beabsichtigt ein Format von den Daten über die Berührungsmuster einzelner Personen zu liefern, das allgemein verständlich und universell eingesetzt werden kann. Die Methode soll mit einem Darstellungsformat präsentiert werden, das Gleichstellungsmerkmale zu anderen etablierten Methoden von partizipatorischen Handlungsweisen im Design besitzt. Der Autor kann den Leser (darin) bestärken, dass Entscheidungen über Inklusion und Exklusion keinesfalls ausschließlich auf Grundlage der Erkenntnisse aus Messwertanalyse getroffen werden sollen.

Proband 1E (0:50)

211	211	211	212	212	212
211	211	211	211	212	212
199	199	199	199	199	199
251	253	253	253	253	253
230	230	230	229	229	230
211	211	245	211	246	211

Fig. 7.19 (oben) Proband 1E Nutzerkarte mit Messwerten

Fig. 7.20 Beidhändiges `kraftvolles´ Greifen

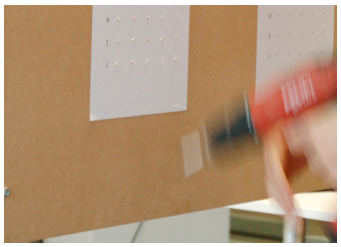


Fig. 7.21

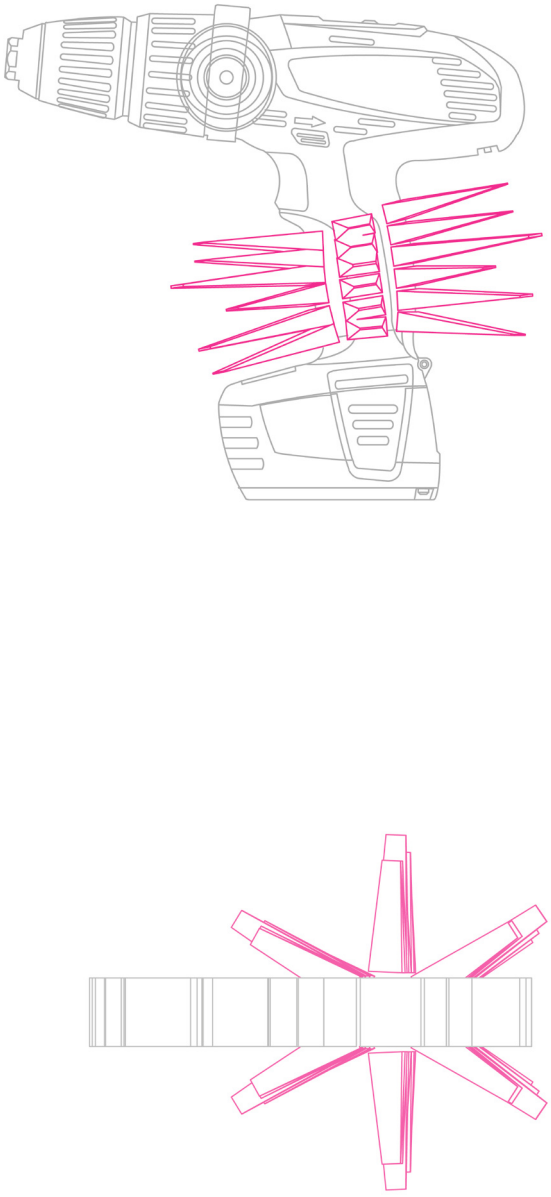


Fig. 7.22 3D Visualisierung von Proband 1E Nutzerkarte auf Basis der Messwerten: Gleichförmigkeit der Graphiken durch beidhändiges Greifen (geschlossener Umfassungsgriff)

7.7 Auswertung und Vergleich zweier Berührungskarten

Die sensor maps 36[3] animierten Rasterzellen von den Probanden 1E (P1E) und 1F (P1F) zeigen zum Zeitpunkt eines Eindrehens der Schrauben (Drücken des Auslösers) sehr unterschiedliche bewegte Bilder.

Proband 1F (0:64)

238	238	238	238	239	238
240	240	239	236	238	233
212	211	211	211	211	210
252	254	254	254	254	254
243	243	243	243	242	243
223	218	218	205	221	213

Fig. 7.23 (oben) Proband 1F Nutzerkarte mit Messwerten

Fig. 7.24 Bild zeigt Einhändigkeit des Porbanden

Fig. 7.25 Ansatz zum Schrauben (offener Umfassungsgriff)

3 Die aktive Messzellen wurden bei Montage des Präprates von 48 auf 36 reduziert, da die Befestigungsenden der horizontalen Griffumspannungen zur stabilen Absicherung für den Test gesichert werden mussten. Diese Sicherung der Verbindungen nahm mehr Raum in Anspruch als vorgesehen, was Messungen in diesen Bereichen unmöglich machte.

1) P1E übte mehr Kraft aus als P1F.

2) Die Verteilung der Berührungen war bei P1E gleichförmiger und weniger stark auf bestimmte Reihen konzentriert wie bei P1F.

Die Fragen nach der Ursache für bestimmte Messbilder insbesondere die ungewöhnlichen Gleichförmigkeit der Druckauflage bei Proband 1F. Aus dem übereinstimmenden Vergleich zwischen den Videos und den sensor maps war ersichtlich, dass P1F (im Gegensatz zu P1E) das Präparat beidhändig benutzte.

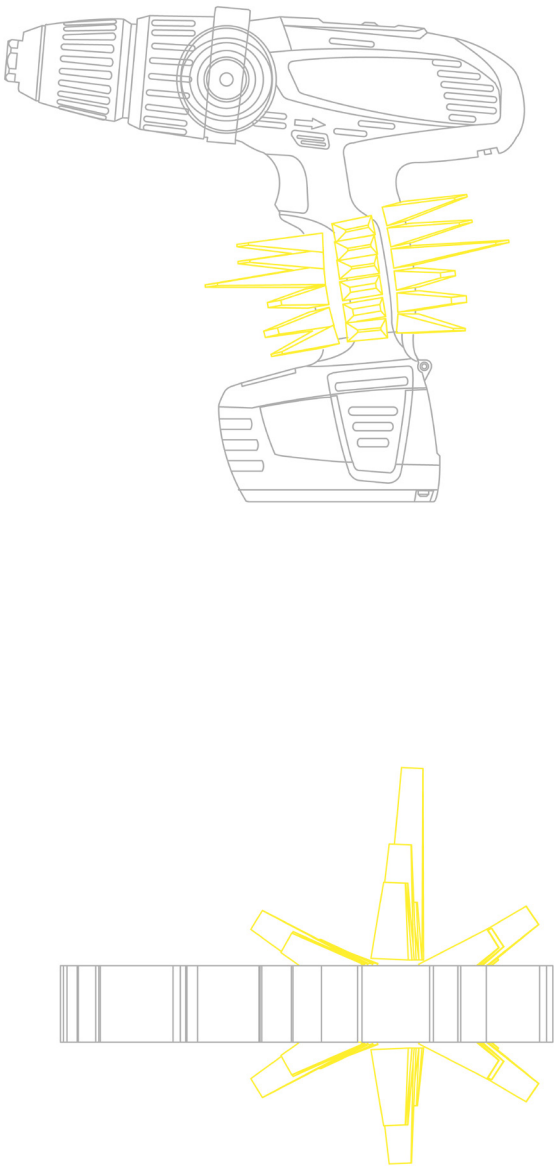


Fig. 7.26 3D Visualisierung von Proband 1F auf Basis Nutzerkarte (Seitenansicht & Aufsicht):

Der Ausschlag der Balken ist weniger stark ausgeprägt und ungleichförmig (aufgrund des einhändigen Greifens).

Diese Feststellung erklärt die Gleichmäßigkeit der Druckauflage bei P1F und die reihenformige, punktuelle Druckverteilung verursacht durch die einhändige Kontaktfläche bei P1E. Warum P1E in der Summe - trotz des doppelhändigen Greifens - mehr Kraft aufwendete als P1F bleibt ungeklärt [4].

Die Angaben aus dem Fragebogen geben über die Probanden folgende Informationen:

P1E

Alter zwischen 31-40,

Weiblich,

Rechtshändig,

1,65 m

Auf die Frage nach der größten Herausforderung des Tages, der Woche, des Monats gab die Propandin an: Treppen steigen. Die Propanding teilte mit schwanger zu sein.

P1F

Alter zwischen 31-40,

Männlich

Gleich ausgebildete Geschicklichkeit beider Hände (ambidextrous)

1,90 m

Auf die Frage nach der größten Herausforderung des Tages, der Woche, des Monats gab der Propand an: Meinen Sohn hochheben. Die Unterschiede bei der Kraftübertragung können auch von den unterschiedlichen Arbeitshöhen zum Eindrehen des Schrauben im Vergleich zu den Körpergrößen der beiden Probanden abgeleitet werden (Abb. Bohrfelder). Eine vollständige Aufschlüsselung der Messdaten kann erst durch zusätzliche Datenerhebungen erfolgen.

7.8 Zusammenfassung

Die Forschung hat durch die Gestaltung programmierter berührungssensitiver Prototypen den Schritt erreicht, erste prüfbare Aussagen über Körpergrössen und Handhabungsmuster zu treffen. Es wurde bestätigt, dass die Methode, auf Basis der Erkenntnisse aus der Anwendung, in der Lage ist, Handhabungsmuster unterschiedlicher Personengruppen in Verbindung zu setzen.[5] Die Beurteilung von „Bedürfniskategorien“ einer Person ausnahmslos auf Basis messbarer numerischer Daten zu treffen, liegt nicht im Interesse des Autors sowie seiner angewandten Nutzerforschung.

4 Bei doppelhändigem Greifen würde man von einer größeren Kraft ausgehen, was aber hier nicht der Fall war. Diese Unstimmigkeit muß durch ergänzende Nutzerforschung erörtert werden.

5 Nach Abschluss der jetzigen Phase und anhand der verfügbaren Daten kann die Frage beantwortet werden, ob die Handhabungsmuster von Probanden ähnlicher Zugehörigkeit spezifische Kriterien besitzen, die deckungsgleich sind, und ob generelle Aussagen über Verhaltensmuster bestimmer Personengruppen getroffen werden können.

Der Autor vertritt nicht die Ansicht, dass die individuellen Eigenschaften und persönlichen Hintergrundinformationen einzelner Probanden im Rahmen einer Berührungsdatenanalyse in Vergessenheit geraten und an Gewichtung bei der Bewertung der Produkttauglichkeit verlieren dürfen. Obwohl der Autor, mit Einsatz des Messverfahrens und nach Abschluss der Datenanalyse, in der Lage ist, begründete Vermutungen (Hypothesen) über verschiedene Gebrauchsweisen und Handhabungsvorlieben abzuleiten. Bei einer Methode, die lediglich auf eine Erhebung parametrische, biometrische und sonstiger messbare Daten über individuelle Personen fokussiert, können Designforscher Gefahr laufen, nicht die real existierenden Personen hinter den Zahlen, Nummern und Messwerten zu sehen. Diesbezüglich, so vermutet der Autor, muss der Anwender bei dem Einsatz der Berührungsmessung Vorsicht walten lassen, da die lediglich auf Basis parametrischer Messwerte erzielten Erkenntnisse über Individuen täuschend wirken können, wenn man diese nicht mit Informationen von etablierten qualitativen Forschungsmethoden abgleicht.

8. Konklusion

An dieser Stelle des Kapitels und der Arbeit muss der Autor erneut verdeutlichen, dass die Entscheidungsträger bei nutzerzentrierten Designprozessen über ein fundiertes Wissen von der Wirkensweise und der Einsatzfähigkeit von qualitativen und quantitativen Methoden haben muß, um nachhaltige Designlösungen zu schaffen. Der Autor hebt den Rang qualitativer Forschung in mitwirkenden Designprozessen hervor. Die Relevanz eines substanziellen Einsatzes unterschiedlicher Methoden mit dem Ziel inklusiver Produktlösungen wurde in dieser Arbeit hinreichend diskutiert. Designer in leitenden Funktionen haben in Entscheidungsfindungsprozessen die Möglichkeit über inklusive, anstatt exklusive Designlösungen zu entscheiden. Selbst geringe Abweichungen im Produktdetail entscheiden über Inklusion oder Exklusion von Menschen. Die in der Produktentwicklung unbedeutend erscheinenden Nuancen führen zu Frustrationen und Ärgernissen bei Nutzern und haben demzufolge gravierende und weitreichende Auswirkungen auf das Lebensgefühl vieler Menschen. Ein, eine möglichst breite und große Nutzerschicht ansprechendes, Design kann nur entstehen, wenn Designer ihre Entscheidungen informativ d.h. auf Basis von ausreichend verfügbaren, relevanten und aufdatierten Daten treffen. Der Schlüssel für die Gestaltung inklusiver Produkte liegt somit in dem freien Zugang zu Informationen von Relevanz und je nach Bedarf und Projekt in derer präziser systematischer Aufarbeitung und Verarbeitung.

Der Autor entschied sich dem Status quo von Mangelhaftigkeit und „Nutzer-desorientiertheit“ in der Produktgestaltung entgegenzuwirken. Er begann vor vier Jahren eine neue Methode zur messbaren Prüfbarkeit von Produktgebrauchstauglichkeit zu entwickeln. Ziel des Vorhabens war und ist es, Designer, Nicht-Designer und alle am Designprozess Beteiligte bei Entscheidungsfragen mit relevanten Daten hinsichtlich einer Nutzerinklusion zu versorgen. Für das Produktdesign ist die Bedeutung von Erkenntnissen durch die Methoden der Ethnographie unumstritten. Ihr Einsatz, Anwendung und Wirkung ist nicht wegzudenken. In der Position eines Produktdesigners als „Anwendungsforscher“[6] (Bartels, 1998) in Verbindung mit einer Überprüfbarkeit von berührbaren Entwurfsideen (Testmodellen) in simulierten Anwenderszenarien und Produkten in situ weist die Methode ein Potential auf, das mit ethnographischer Forschungsmethodik unerreichbar ist. Das Gewicht liegt auf der Messbarkeit von Berührungen und der darin enthaltenen Aussagekraft über Bedürfnisse von Handhabung und Komfort und deren Akzeptanz durch individuelle Nutzergruppen. Die Methode der Berührungsmessung tritt in dem Moment eines Designprozesses in Kraft, wenn Konzeptideen eines Produktdesigner in Form von realen physischen Modellen übertragen und im Raum greifbar werden.

6 […] Experimentelle Materialien oder Verfahren werden heute erst durch den Entwurf ihrer Anwendungsbereiche zu Produkten weiterentwickelt.´ (Bartels, Huber, Oertl, 1998)

Das generierte Wissen aus ethnographischen Methoden (field ethnography, digital and photo ethnography, personae) sowie der Import von Erkenntnissen aus einer mitwirkenden Zusammenarbeit mit Fokusgruppen (mini focus groups, 1-on-1 interviews, dyads, triads, online discussion groups) führt zu innovativen Produktlösungen und zur Neugestaltung aktueller Produkte, Systeme und Dienstleistungen. Die genannten angewandten Methoden der nutzerorientierten und partizipatorischen Produktentwicklung sind geprüfte, erprobte und etablierte Verfahren im Produktdesign. Die Lehre von Methoden der Spurensuche und der Berührungsmessung, die in Kapiteln 6 und 7 bzw. in 8 bis 10 behandelt und beschrieben wird, kann als „neuartige Verfahrensentwicklung von nutzerzentrierten Designwerkzeugen auf dem Weg zu universell gebrauchstauglichen Produktlösungen“ bezeichnet werden. Die Spurensuche kann charakteristisch als rückwirkungsfreie und omnipräsente Methode beschrieben werden. In der Anwendung eröffnet das Suchen, Ausfindigmachen und Decodieren von Spuren, durch einen realen Gebrauch verursachte Hinterlassenschaften[7], einen aussagekräftigen Wissensinput über Handhabungsvorlieben in unterschiedlichen Nutzergruppen. Der „Spurenleser“ wird somit in die Lage versetzt, bedeutende Erkenntnisse über Produkte in situ zu sammeln. Der Autor definiert Spuren, durch Abrieb, Auftrag oder in Form von Überbleibseln, allgemein als „Zeitzeugen eines realen Produktgebrauchs“. Diese Untersuchungsverfahren beschreibt der Autor als neue Methode der Kreativtechnik, deren Ansatz universalen Prinzipien entspricht.

Die Berührungsmessung als Methode erhält im laufenden Designprozeß dann Einzug, wenn Produktideen in Form von körperlichen Modelle repräsentiert werden können. Der Autor setzt idealer Weise den Beginn der Prototypenphase gleich mit dem Beginn der Berührungsmessungsphase. In diesem Kontext ergibt eine Methodenüberlagerung von Methoden des Usabilitytestings und der Berührungsmessung mit Entwurfsmodellen (mock-ups), Prototypen und Betaversionen zur Generierung von prüfbarer Daten einen Sinn. Auf diese Weise können Designer erst ihre entwickelten Designlösungen, die von Nutzern gefordert wurden, mit physischen Testmodellen austesten. Die Nachprüfbarkeit von Nutzerbedürfnissen kann ein Vorteil für Designer sein, wenn sie ihre Entwürfe bei ihren Auftraggebern präsentieren müssen. Die Berührungsmessung liefert für die gestalterische Entscheidungen im Design genügend Beweise, durch die Methode der messbaren Daten. Eine Kombination aus einer qualitativen Beweisführung mit prüfbaren Informationen kann Designer dabei unterstützen, ihre Auftraggeber, die Öffentlichkeit und vor allem Skeptiker der kreativen Techniken von Entwurfsideen zu überzeugen. Die Designer erhalten somit für ihr finales Projekt-„Plädoyer“ ergänzend zu den Bedürfnisdefinitionen auf Basis von ethnographischen Methoden ein Werkzeug der wissenschaftlichen Beweisführung und können somit mit Bedenkenträgern auf Augenhöhe verhandeln.

7 Für den Autor kann eine Hinterlassenschaft in dem Kontext auch als Relikt oder Rudiment beschrieben werden.

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